



**United States Environmental Protection Agency-Region III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029**

Watershed Report for Chester Creek, Pennsylvania

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1.0 Introduction

The purpose of this report is to describe the current condition of the Chester Creek watershed and present the data available for further analysis and TMDL development. It supplements the report entitled *Nutrient Total Maximum Daily Load in Goose Creek Watershed, Pennsylvania*. This section explains the background and regulatory information pertinent to the impairments in the Chester Creek watershed.

1.1 Water Quality Impairments

Section 303(d) of the Clean Water Act and the Environmental Protection Agency's (EPA) Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for waterbodies that are not supporting their designated uses.

Pennsylvania's 1996 Section 303(d) List identified the entire mainstem of Goose Creek (stream code 520) as having "other" impairments due to municipal point sources. Additionally, the Pennsylvania's 1996 Section 303(d) List identified the mainstem of Goose Creek as being impaired for "other organics" due to an "undetermined" source. PADEP later identified four unnamed tributaries to Goose Creek (stream codes 616, 617, 618, and 619) as impaired due to priority organics from sources unknown on the 1998 list, and unknown causes due to municipal point sources on the 2002 list. Based on available data and information, PADEP biologists have since interpreted the unknown causes for all of these listings to organic enrichment and nutrient impairments. In fact, historically and currently, the available data for total phosphorus concentrations in Goose Creek measured downstream from the two major wastewater treatment facilities (Goose Creek WWTP and West Goshen Township Sewer Authority) showed consistently elevated levels. For instance, total phosphorus concentration at PADEP monitoring station GC-2 (downstream from the discharger Goose Creek WWTP) ranged between 0.3 and 4.0 mg/L in the nineties and between 1.5 and 2.4 mg/L in 2006. Similarly at PADEP monitoring station GC-4 located downstream at the discharger West Goshen Township Sewer Authority, total phosphorus concentrations ranged between 2.6 and 3.5 mg/L in

the 1990's and between 1.6 and 1.7 mg/L in 2006 (Figures A-13 through A-16 in Appendix A). A more detailed analysis is provided in Section 3.

It should be noted that the segments listed as impaired due to priority organics on Goose Creek are in fact the same segments impaired due to nutrients and organic enrichment. The priority organics listings were initially identified by PADEP after a chemical spill incident above the Goose Creek WWTP. The original listing was for toluene, xylene, PCE, and chloroform. Since this was a one-time event rather than a chronic impairment, these waters should not have been listed for priority organics. Additionally, samples collected by PADEP in the fall of 2006 found no presence of toluene or xylene and levels of PCE and chloroform that are below the aquatic life and human health criteria. T

Two stream segments of Chester Creek (stream codes 520 and 601) were also reported on Pennsylvania's 1996 and 2002 303(d) list as impaired due to siltation from hydromodification. Segment 520 (Assessment ID 128) was reported on Pennsylvania's 1996 303(d) list as impaired due to suspended solids from municipal point source. The stream segments in the Chester Creek watershed are presented in **Figure 1-1**.

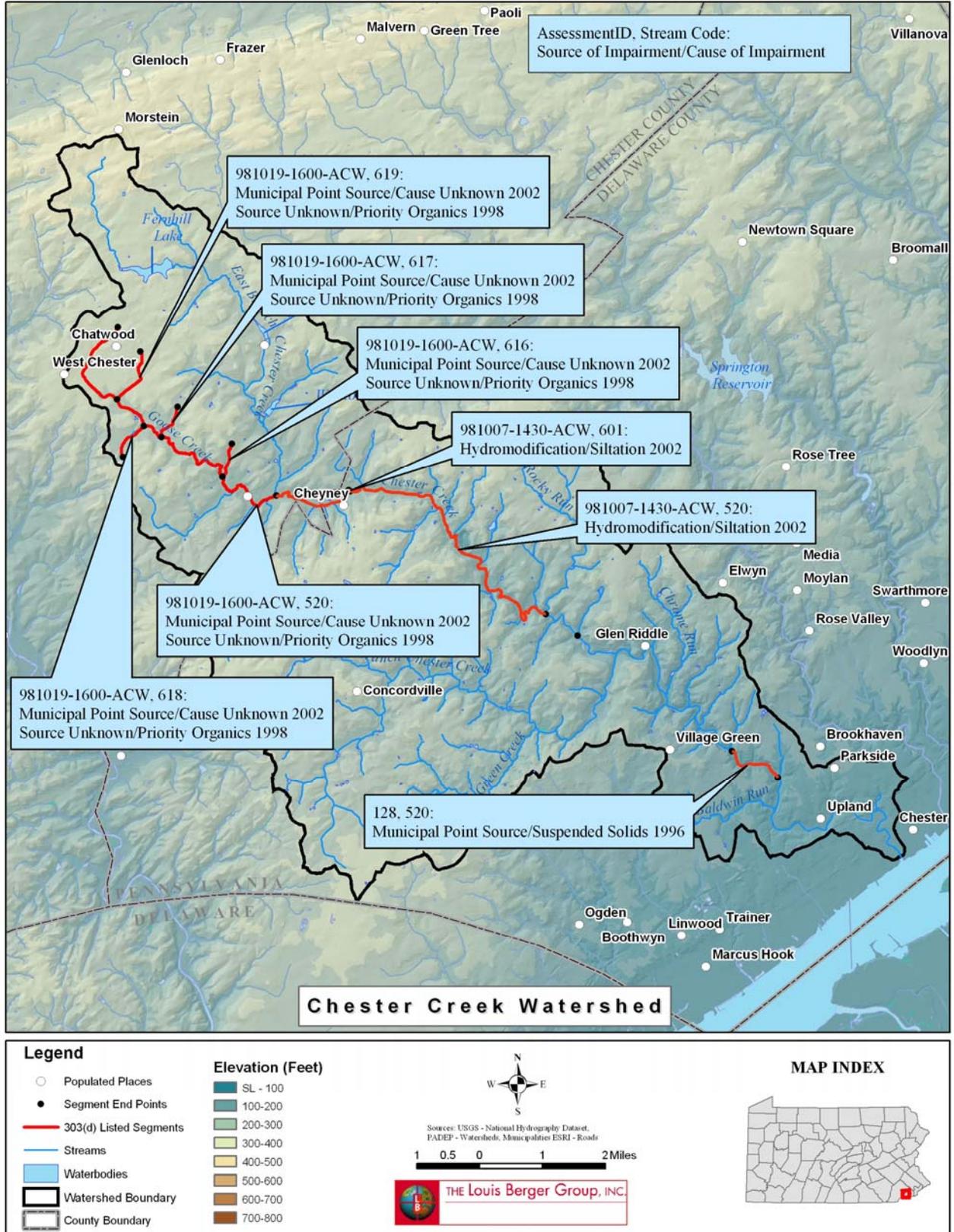


Figure 1-1: Impaired Segments in the Chester Creek Watershed

1.2 Applicable Water Quality Standards

Water quality standards consist of designated uses for a waterbody and the water quality criteria necessary to support those designated uses, as well as an antidegradation section. According to Pennsylvania Water Quality Standards, the term *water quality criteria* is defined as “numeric concentrations, levels or surface water conditions that need to be maintained or attained to protect existing and designated uses.”

1.2.1 Designated Uses

Pennsylvania Water Quality Standards (25 PA Code Chapter 93, specifically § 93.3) designate water uses which shall be protected, and upon which the development of water quality criteria shall be based. These include the protection of potable water supplies as defined by the Federal Safe Drinking Water Act (42 U.S.C.A. § 300F), or by other water users that require a permit from the Department under the Pennsylvania Safe Drinking Water Act (35 P. S. § 721.1—721.18), as well as water supply for wildlife, industry, livestock, and irrigation. The maintenance and propagation of aquatic life, including coldwater and warmwater fisheries, and anadromous and catadromous fishes which ascend into flowing waters to complete their life cycle, are also protected as designated uses of Pennsylvania’s waters. Pennsylvania Water Quality Standards also serve to designate waters in the state for primary contact recreation, fishing, boating, esthetics, and navigation. **Table 1.1** shows the designated uses for the 303(d) listed segments.

Table 1-1: Designated Water Uses of 303(d) Listed Segments					
303(d) Listed Segment (Assessment ID, Stream Code)	Stream Name	Designated Water Uses ^{1,2}	303(d) Impairment	Source	Original Listing Year
981019-1600-ACW, 520	Goose Creek	TSF	Cause Unknown	Municipal Point Source	1996
			Priority Organics	Source Unknown	1996
981019-1600-ACW, 619	UNT to Goose Creek	TSF	Cause Unknown	Municipal Point Source	2002
			Priority Organics	Source Unknown	1998
981019-1600-ACW, 618	UNT to Goose Creek	TSF	Cause Unknown	Municipal Point Source	2002
			Priority Organics	Source Unknown	1998
981019-1600-ACW, 617	UNT to Goose Creek	TSF	Cause Unknown	Municipal Point Source	2002
			Priority	Source Unknown	1998

Table 1-1: Designated Water Uses of 303(d) Listed Segments

			Organics		
981019-1600-ACW, 616	UNT to Goose Creek	TSF	Cause Unknown	Municipal Point Source	2002
			Priority Organics	Source Unknown	1998
981019-1600-ACW, 616	UNT to Goose Creek	TSF	Cause Unknown	Municipal Point Source	2002
981007-1430-ACW,601	Chester Creek	TSF, MF	Siltation	Hydromodification	2002
981007-1430-ACW,520	Chester Creek	TSF, MF	Siltation	Hydromodification	2002
128, 520	Chester Creek	WWF, MF	Suspended Solids	Municipal Point Source	1996
¹ Based on § 93.9g of the Code of Pennsylvania the following uses apply to Goose Creek: TSF ² TSF – Trout Stocking					

In the subsequent sections of this report, sources of nutrients and sediment in the watershed are described and analyzed. After reviewing the available watershed and environmental monitoring data, estimates of existing phosphorus and sediment loads to the stream are presented.

2.0 Watershed Characterization

The purpose of the watershed characterization is to provide an overview of conditions in the watershed as they relate to the impairment listings. In particular, watershed physical features such as topography, soil types, and land use types are inventoried and assessed. In addition, any permitted discharge facilities or water quality monitoring stations present in the watersheds are documented. Information obtained from the watershed characterization is then used in identifying potential pollutant(s) causing the impairment, as well as for the subsequent TMDL development.

2.1 *Physical Characteristics*

Important physical characteristics of the Chester Creek watershed were analyzed using GIS coverages and other ancillary information describing its physical condition. GIS coverages of the watershed boundary, stream network, topography, soils, land use, and ecoregion were compiled and analyzed from the following primary sources:

- BASINS – EPA
- National Land Cover Dataset (NLCD) – USGS
- National Hydrography Dataset (NHD) – USGS
- STATSGO – State Soil Geographic Database, NRCS

2.1.1 Watershed Location and Boundary

The Chester Creek watershed straddles the Chester and Delaware County boundary, with approximately one third of the watershed in Chester County to the north and the remaining area in Delaware County to the south (**Figure 2-1**). The Chester Creek

Watershed Report for Chester Creek

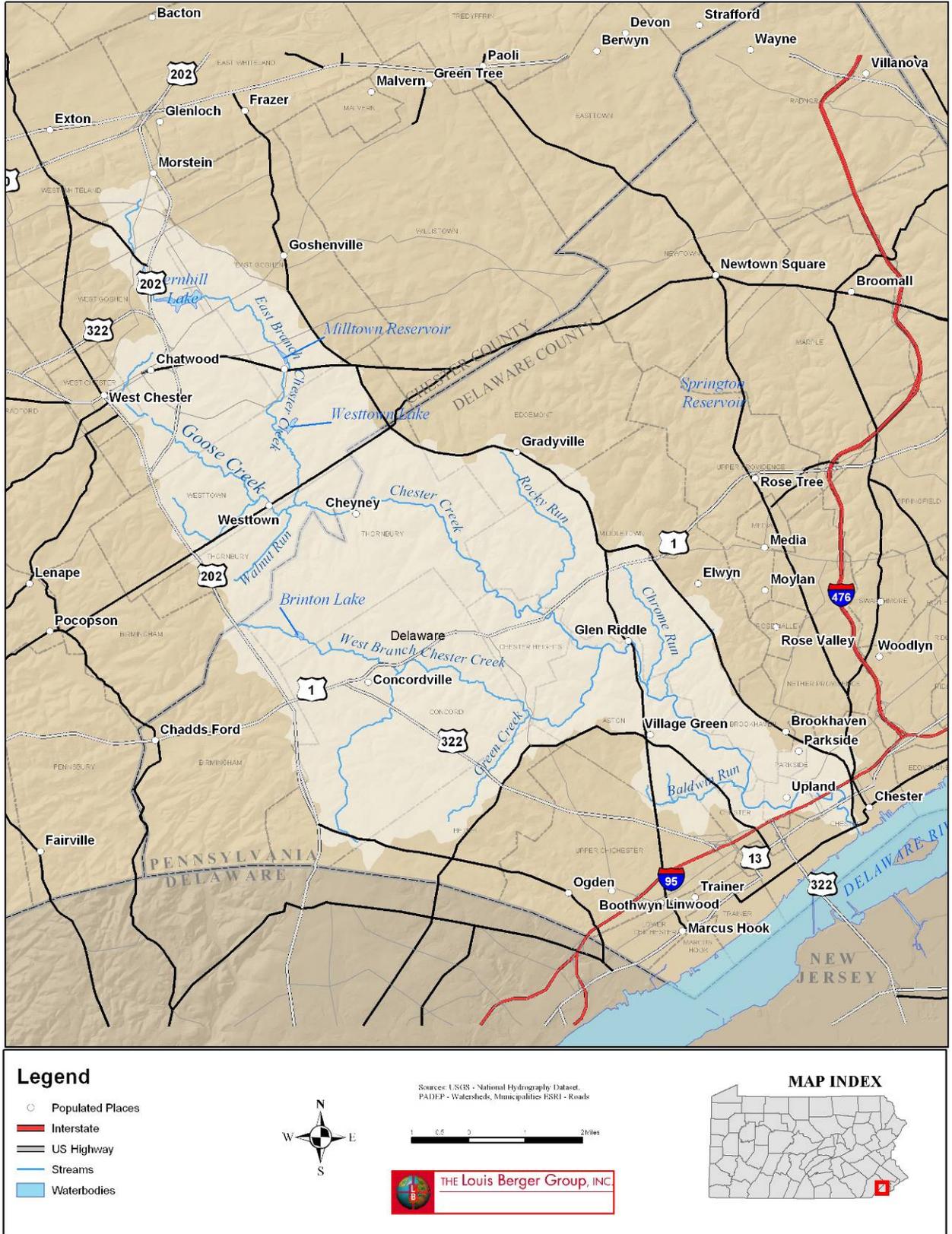


Figure 2-1: Chester Creek Vicinity Map

watershed is approximately 42,472 acres or roughly 66 square miles in area, and drains southward to its confluence with the Delaware River at Chester, Pennsylvania.

Major transportation routes in the vicinity of the watershed include: US Route 202/322 and Interstate 476, which follow north to south orientations along the west and east sides of the watershed (respectively); US Route 1 (Baltimore Pike), which passes east to west through the lower third of the watershed; and Interstate 95, which follows a path roughly parallel to US Route 1 crossing through the watershed at its southern tip (**Figure 2-1**).

2.1.2 Stream Network

The stream network for Chester Creek was mapped and analyzed using the most current high resolution version of the National Hydrography Dataset (NHD) available (**Figure 2-2**). There is approximately 132 miles of stream courses in the watershed, 17 miles of which are listed as impaired based on the PADEP GIS data layer – some of these streams were first listed in 1996, 1998, and 2002. Only the Section 303(d) listings identified in Table 1-1 will be considered in this TMDL development, and the remaining will be addressed by future TMDLs.

Major tributaries are listed in **Table 2-1**, and account for approximately 7% of the total stream mileage. East Branch Chester Creek and Goose Creek are the major streams draining the northern portion of the watershed. The mainstem of Chester Creek begins near the confluence of these two streams flowing southward roughly 20 miles to the Delaware River. Several smaller tributaries, such as Rocky Run, Chrome Run, and Baldwin Run, feed Chester Creek along its path. West Branch Chester Creek, which drains roughly 19 square miles of the southwestern portion of

Table 2-1: Length of Major Tributaries in Chester Creek Watershed	
Stream Name	Length (miles)
Chester Creek	20.6
West Branch Chester Creek	9.3
East Branch Chester Creek	9.0
Webb Creek	4.2
Rocky Run	4.2
Green Creek	2.8
Chrome Run	2.7
Baldwin Run	2.3
Walnut Run	1.8
Crum Run	1.7
Dutton Run	0.8
Unnamed	73
Total	132.3

the watershed, joins Chester Creek near Glen Riddle. The majority of the remaining stream mileage in the watershed is comprised of smaller unnamed tributary streams feeding directly into the Chester, East Branch Chester, and West Branch Chester Creeks.

2.1.3 Topography

A 30-meter digital elevation model (DEM) and USGS 7.5 minute quadrangle maps were used to characterize topography in the watershed. Elevations in the watershed ranged from 0 to 612 feet above mean sea level with an average elevation of 317 feet.

The steepness and distribution of slopes in the watershed has a significant effect on the hydrologic character of a given watershed. In general, watersheds with a high proportion of their area in low slope classes tend to have a greater proportion of rainfall reabsorbed into the soil before becoming surface runoff. In contrast, watersheds with a significant portion of their area in higher slope classes tend to have more rapid conversion of rainfall to runoff and more flashy flow characteristics. Based on slope calculations developed using the DEM, slopes in the watershed (calculated as percent slope) ranged from 0% to 73%, with the average slope in the watershed approximately 8%. Slope classes in the watershed are presented below in **Table 2-2**.

Table 2-2. Percent Slope Classes in the Chester Creek Watershed by Proportion		
Slope Classes	Acres	Proportion of Watershed
0 - 2%	4,713	11.1%
2 - 5%	11,894	28.0%
5 - 10%	15,213	35.8%
10 - 25%	9,212	21.7%
25 - 50%	1,426	3.4%
>50%	14	0.0%
TOTAL	42,472	100%

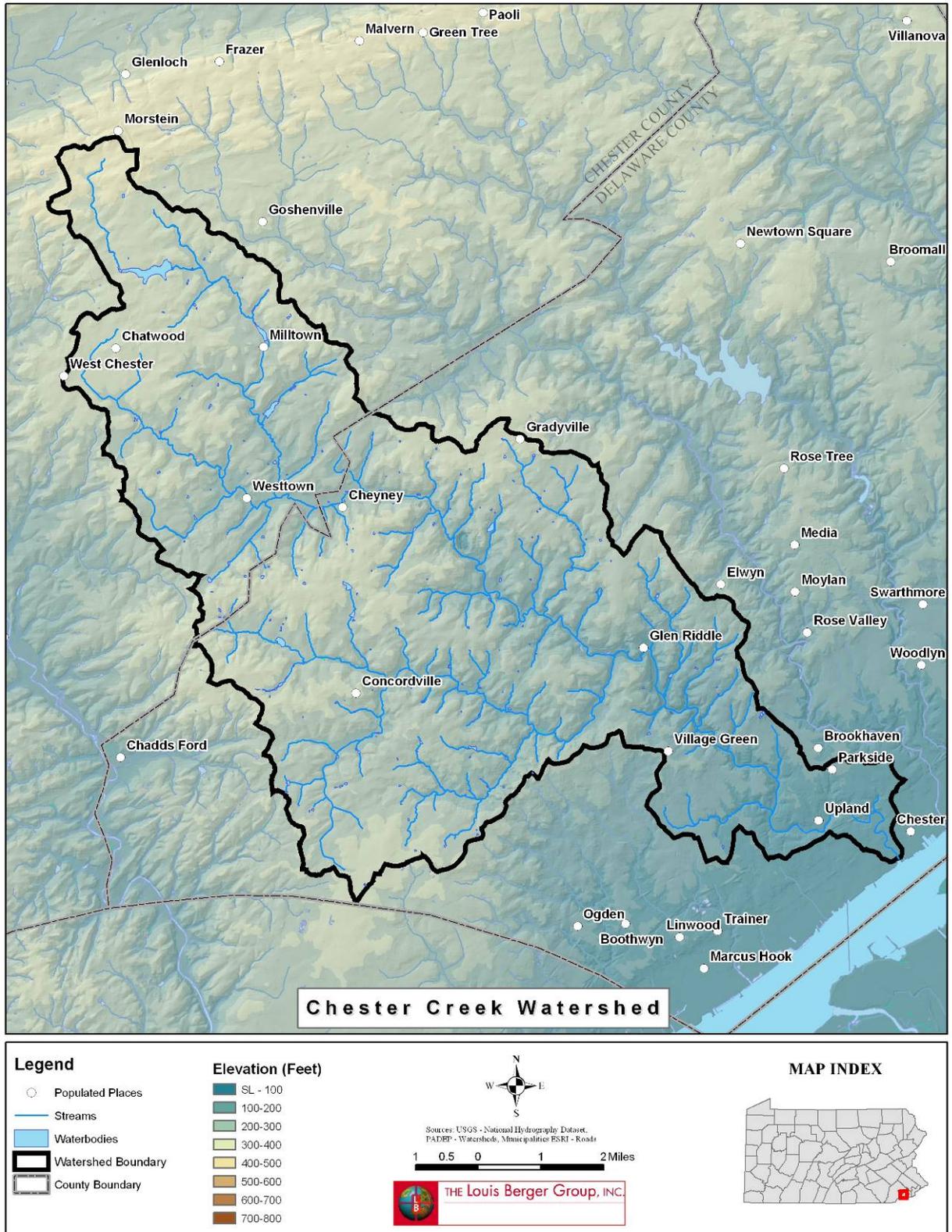


Figure 2-2: Stream Networks and Topography

2.1.4 Soils

Although detailed county level soil survey data is available in GIS form for Delaware County, similar information is not currently available for Chester County. As a result, state level soil characterization data, the State Soil Geographic (STATSGO) dataset, was used in the following characterization of soil conditions. STATSGO data is prepared by delineating generalized map unit areas that show similar combinations of soil types in reasonably predictable proportions.

Two STATSGO soil map units found north of the Delaware River floodplain comprise the majority (93%) of the Chester Creek Watershed (**Figure 2-3**). The first is dominated by the Chester and Glenelg soil series which are both considered very deep, well drained, moderately permeable soils derived from weathered micaceous schist. The second soil map unit is dominated by the Lehigh, Neshaminy, and to a lesser extent, the Glenelg soil series. The Neshaminy soil series are deep to very deep well drained soils formed from weathered diabase and other dark colored basic rocks. Soils of the Lehigh series are deep, moderately well and somewhat poorly drained soils derived from residuum of metamorphosed sandstone and shale. A third soil map unit in the watershed is only found in a small portion of the southern tip of the watershed, and is comprised predominately (more than 50%) of areas delineated as urban, i.e. areas of disturbed or highly modified soils. The soil series of next highest proportion in this map unit include the Westbrook soil series, which consists of very deep, very poorly drained soils formed in organic deposits over loamy mineral material, and the Pit soil series, which are very deep, poorly drained soils that formed in fine-textured alluvium.

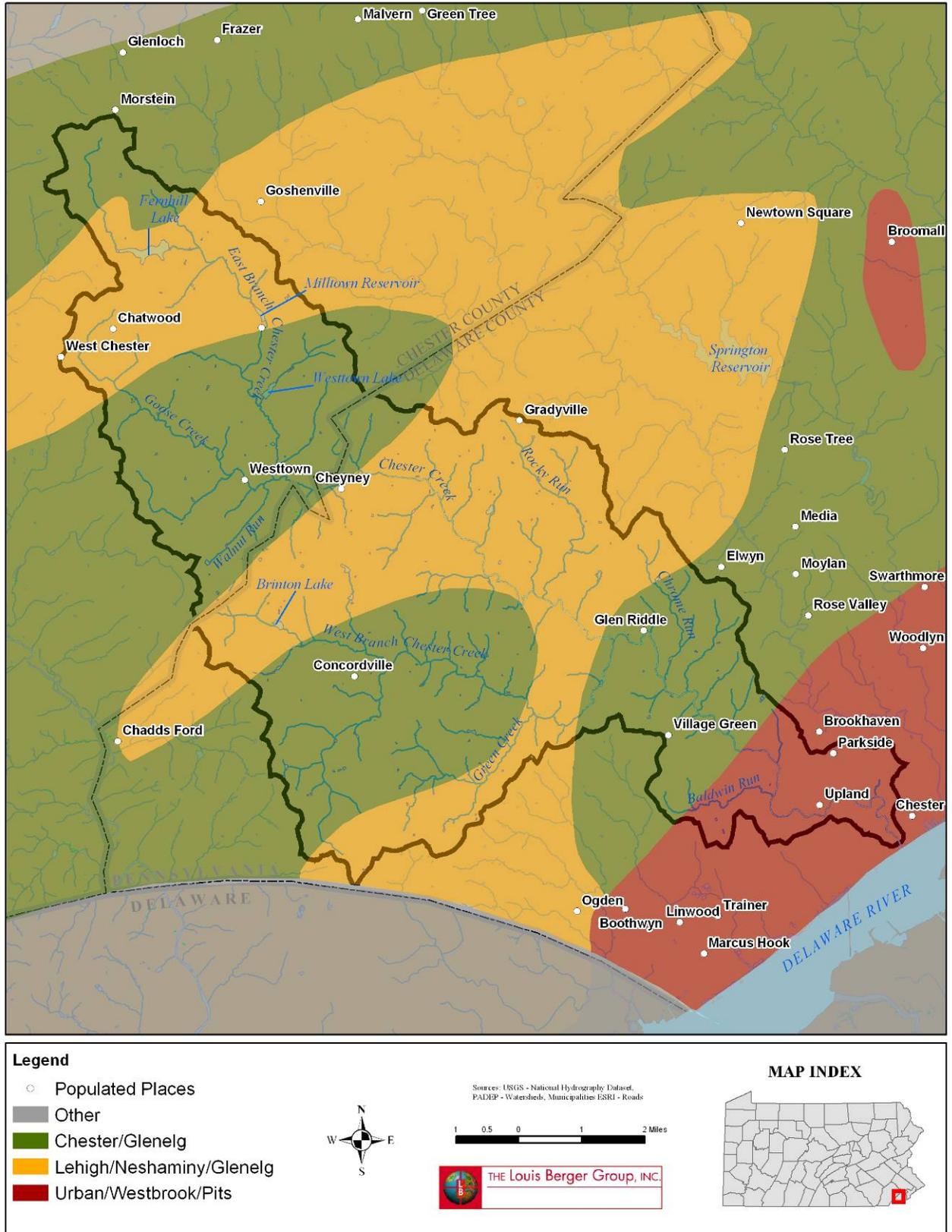


Figure 2-3: STATSGO Soil Map Units in the Chester Creek Watershed

Table 2-3 lists the STATSGO soil map units found in the watershed.

Table 2-3 STATSGO Soil Map Units in the Chester Creek Watershed					
Map Unit ID	Soil Associations	Hydrologic groups	Weighted K	Acres	Proportion of Watershed
PA061	Chester/Glenelg	B	0.32	21,716	51%
PA062	Lehigh/Neshaminy/Glenelg	B/C	0.33	17,941	42%
PA072	Urban/Westbrook/Pits	D	0.28	2,814	7%
TOTAL			0.31	42,471	100%

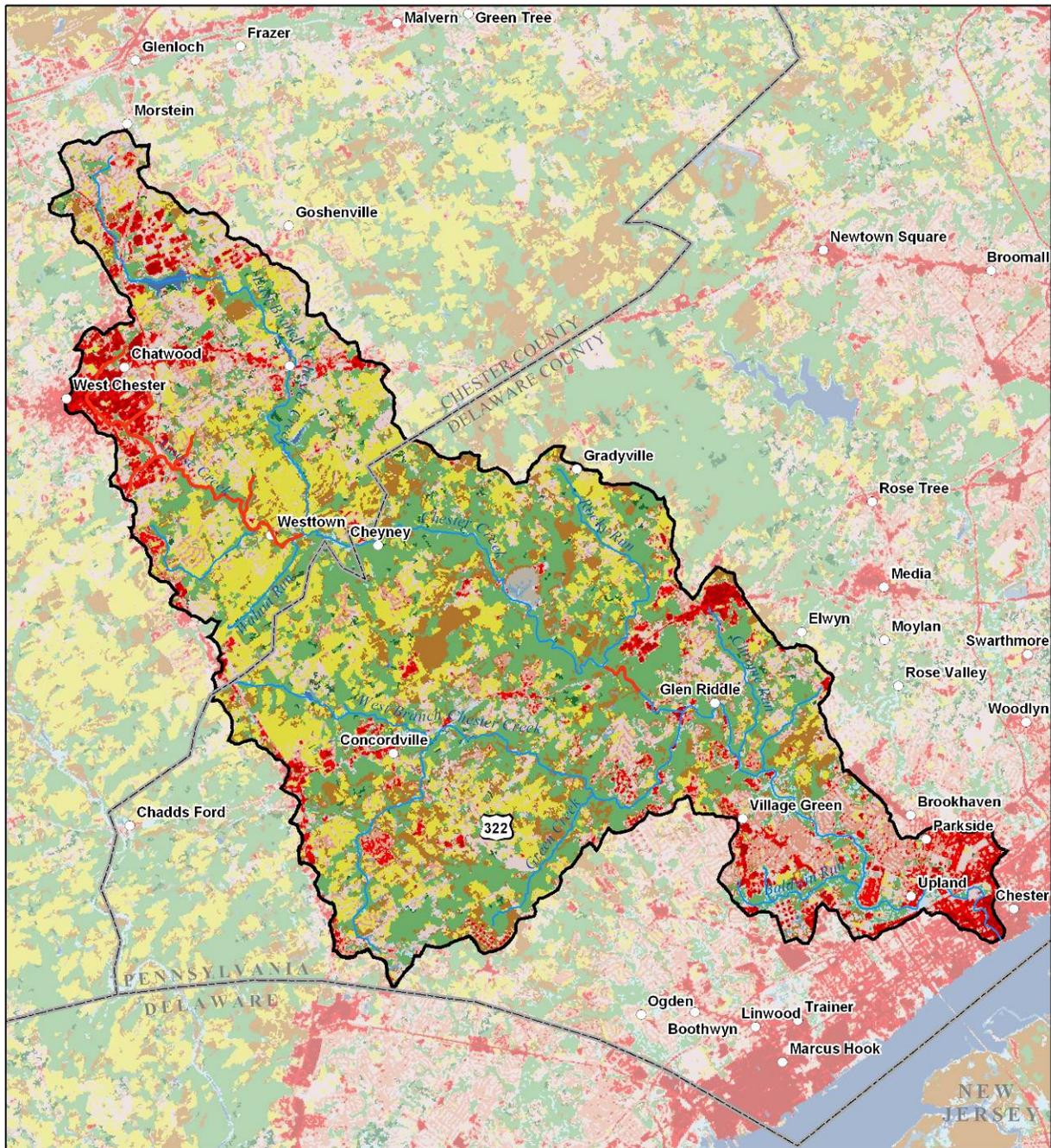
The hydrologic soil groups represent different levels of infiltration capacity of the soils as described in **Table 2-4**. Hydrologic soil group “A” designates soils that are well to excessively well drained, whereas hydrologic soil group “D” designates soils that are poorly drained. This means that soils in hydrologic group “A” allow a larger portion of the rainfall to infiltrate and become part of the ground water system. Conversely, soils in hydrologic group “D” allow a smaller portion of the rainfall to infiltrate and become part of the ground water. Consequently, more rainfall becomes part of the surface water runoff in hydrologic group D. Although areas of lower infiltration rate, and therefore higher runoff potential, dominate in the southern portion of the watershed, the majority of the Chester Creek watershed is dominated by soils of moderate to moderately slow infiltration rates.

Table 2-4. Descriptions of Hydrologic Soil Groups	
Hydrologic Soil Group	Description
A	High infiltration rates. Soils are deep, well drained to excessively drained sand and gravels.
B	Moderate infiltration rates. Deep and moderately deep, moderately well and well-drained soils with moderately coarse textures.
C	Moderate to slow infiltration rates. Soils with layers impeding downward movement of water or soils with moderately fine or fine textures.
D	Very slow infiltration rates. Soils are clayey, have high water table, or shallow to an impervious cover

2.1.5 Land Use

Land use characterization was based on 2001 National Land Cover Data (NLCD) developed by USGS. The distribution of land uses in the Chester Creek watershed, by land area and percentage, is presented in **Table 2-5**. Developed lands comprise a relatively large proportion (33.6%) of the Chester Creek watershed, with the majority of the remaining area comprised of forested lands (29.3%) and agricultural land uses (33.7%). Wetlands and barren lands comprise only a minor portion of the watershed (<4%). **Figure 2-4** displays a map of the land uses within the Chester Creek watershed. Brief descriptions of land use classifications are presented in **Table 2-6**.

Table 2-5. Chester Creek Watershed Land Use Distribution				
General Land Use Category	NLCD Land Use Type	Acres	Fraction of Watershed	Total Percent
Water/Wetlands	Open Water	91	0.21%	2.17%
	Woody Wetlands	717	1.69%	
	Emergent Wetlands	112	0.26%	
Developed	Open Space	6,910	16.27%	33.6%
	Low Intensity	4,225	9.95%	
	Medium Intensity	2,283	5.37%	
	High Intensity	854	2.01%	
Agriculture	Pasture Hay	9,058	21.33%	33.7%
	Cultivated Crops	5,267	12.40%	
Forest	Deciduous Forest	12,061	28.40%	29.2%
	Evergreen Forest	355	0.84%	
	Mixed Forest	4	0.01%	
Other	Barren Land	535	1.26%	1.26%
Total		42,472	100.00%	100.00%



Legend

○ Populated Places	■ Deciduous Forest
▭ County Boundary	■ Evergreen Forest
■ Open Water	■ Mixed Forest
■ Developed Open Space	■ Pasture Hay
■ Developed Low Intensity	■ Cultivated Crops
■ Developed Medium Intensity	■ Woody Wetlands
■ Developed High Intensity	■ Emergent Wetlands
■ Barren Land	

Sources: USGS - National Hydrography Dataset, FAO/EP - Watersheds, Municipalities ESRI - Roads

1 0.5 0 1 2 Miles

MAP INDEX

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Figure 2-4: Land Use in the Chester Creek Watershed

Table 2-6. Descriptions of NLCD Land Use Types

Land Use Type	Description
Open Water	All areas of open water, generally with less than 25% cover of vegetation or soil.
Woody Wetlands	Areas where forest or shrub land vegetation accounts for greater than 20 percent of vegetative cover and the soil or substrate is periodically saturated with or covered with water.
Emergent Herbaceous Wetlands	Areas where perennial herbaceous vegetation accounts for 75-100 percent of the cover and the soil or substrate is periodically saturated with or covered with water.
Developed, Open Space	Includes areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20 percent of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes
Developed, Low Intensity	Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20-49 percent of total cover. These areas most commonly include single-family housing units.
Developed, Medium Intensity	Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50-79 percent of the total cover. These areas most commonly include single-family housing units.
Developed, High Intensity	Includes highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80 to 100 percent of the total cover.
Pasture/Hay	Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20 percent of total vegetation.
Cultivated Crops	Areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20 percent of total vegetation. This class also includes all land being actively tilled.
Deciduous Forest	Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75 percent of the tree species shed foliage simultaneously in response to seasonal change.
Evergreen Forest	Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75 percent of the tree species maintain their leaves all year. Canopy is never without green foliage.
Mixed Forest	Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75 percent of total tree cover.
Barren Land	Barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.

Source: National Land Cover Data (NLCD) (http://www.mrlc.gov/nlcd_definitions.asp)

2.1.6 Ecoregions

The Chester Creek watershed is located within the Piedmont Uplands and the Delaware River Terraces and Uplands ecoregions (Level IV Ecoregions, classification numbers 64c and 63a respectfully; Woods et al., 1999). The majority of the Chester Creek watershed is within the Piedmont Uplands ecoregion (98%), while only a small portion is in the Delaware River Terraces and Uplands ecoregion (2%). The following ecoregion descriptions are taken from Woods *et al.* (1999).

The Piedmont Uplands ecoregion extends from northern Virginia to southeastern Pennsylvania. It is characterized by rounded hills, low ridges, relative high relief, and narrow valleys and is underlain by metamorphic rock. Extensive urban, commercial, and industrial development occurs in the Philadelphia area. Suburban development is common, especially near Philadelphia, Wilmington, and the major transportation corridors. Farms become progressively more common with distance from the cities. Grain, potatoes, and hay are produced and many of the farms have pastures for dairy and beef cattle or ranges for poultry. Agricultural erosion has been a serious problem in many places.

The Delaware River Terraces and Uplands ecoregion is adjacent to the Delaware River estuary and Delaware Bay that extends from southeastern Pennsylvania to southeastern Delaware. It is characterized by low, nearly level terraces, an ocean modified climate, a long growing season, freshwater inter-tidal marshes, saltwater marshes, and small, sluggish, meandering streams. The northern part of the ecoregion is dominated by Philadelphia, Wilmington, and their suburbs; these cities developed on the Fall Line next to the Delaware River estuary. In this area, urban and industrial activities have caused extensive pollution and habitat modification. Erosion, urban development, dredging, filling, and bulk heading have eradicated many wetlands and continue to have an impact on the few that still exist. The remaining freshwater intertidal marshes in the Pennsylvania portion of the ecoregion are home to globally rare species and this habitat is severely endangered in Pennsylvania.

2.2 Monitoring Data

The following section provides information concerning the available data used for the development of the nutrient TMDLs for the Chester Creek watershed.

2.2.1 Water Quality Data

Numerous sites in the watershed have been sampled for either ambient water quality, biological communities, and/or assessed for aquatic habitat characteristics. Sampling has been conducted by two agencies, the Pennsylvania Department of Environmental Protection (PADEP) and the United States Geological Survey (USGS), as well as two community groups, the Chester Ridley Crum Volunteer Monitoring Program and Chester Creek Watershed Association.

Pennsylvania Department of Environmental Protection (PADEP)

Much of the initial data provided by PADEP was collected in the 1990s. More recent data were collected in 2005 and 2006. These monitoring efforts can be described in the following groups:

1. PADEP monitoring data collected before 2005
2. PADEP monitoring data collected in 2005
3. PADEP monitoring data collected in 2006.

Further discussion describing and analyzing the data can be found in Section 3. Appendix A provides the complete data set used for completing the Nutrient TMDLs.

United States Geological Survey (USGS)

The United States Geological Survey (USGS) has conducted biological and chemical sampling at five sites in the watershed in Chester County (**Table 2-7**). Two of these sites are on Chester Creek, while the remaining three lie on tributaries of Chester Creek. Sampling at these sites has been performed roughly once per year from 1970 to 1997.

Table 2-7. Summary of USGS Monitoring Program

USGS Station Number	Data Type	Period	Frequency
USGS - 01476790	Biological/Chemical	1970-1997	Yearly
USGS - 01476830	Biological/Chemical	1970-1997	Yearly
USGS - 01476835	Biological/Chemical	1970-2003	Yearly
USGS - 01476840	Biological/Chemical	1981-1982, 1988-1997	Yearly
USGS - 01476848	Biological/Chemical	1983-1997	Yearly

Community Water Quality Monitoring Programs

The Chester Ridley Crum Volunteer Monitoring Program has four ambient water quality sampling sites in the Chester Creek watershed, all located at road crossings. Much of the sampling was done in 2000, 2004, and 2005. The Chester Creek Watershed Association has conducted a number of watershed surveys and nutrient profiles in the watershed, sampling 18 different areas for ambient water quality in 2004 and 2005. Data from the Chester Ridley Crum and Chester Creek Watershed Association are presented in **Table 2-8**.

Table 2-8. Private Groups in the Chester Creek Watershed

Agency	Location	Data Type/ Frequency (if applicable)	Collection Period(s)	Number of Samples
Chester Ridley Crum Volunteer Monitoring Program	Westbourne Rd and Goose Creek	Ambient/ Monthly	May 2004-June 2004, August 2004, October 2004-July 2005	14
Chester Ridley Crum Volunteer Monitoring Program	Goose Creek and Oakbourne Rd	Ambient/ Monthly	May 2004, October 2004-July 2005	11
Chester Ridley Crum Volunteer Monitoring Program	Chester Creek and Sweetwater Rd, Glen Mills	Ambient/ Monthly	October 2000-June 2005	50
Chester Ridley Crum Volunteer Monitoring Program	Chester Creek	Ambient/ Monthly	January 2004-September 2005	21

Table 2-8. Private Groups in the Chester Creek Watershed

Chester Ridley Crum Volunteer Monitoring Program	Chester Creek and Locksley Road	Ambient ¹	April 2004, August 2005	3
Chester Ridley Crum Volunteer Monitoring Program	East Branch of Chester Creek and Westtown Rd	Ambient	April 2004	1
Chester Ridley Crum Volunteer Monitoring Program	Goose Creek and Trellis Rd	Ambient	April 2004	1
Chester Ridley Crum Volunteer Monitoring Program	Goose Creek and PA Route 926	Ambient ²	April 2004, March 2005, August 2005	4
Chester Ridley Crum Volunteer Monitoring Program	Chester Creek and Sweetwater Road(Glen Mills)	Ambient	April 2004, March 2005, August 2005	3
Chester Ridley Crum Volunteer Monitoring Program	Chester Creek at Lenni	Ambient	April 2004, March 2005	2
Chester Ridley Crum Volunteer Monitoring Program	Mouth of West Branch Chester Creek and Convent Rd	Ambient	April 2004	1
Chester Ridley Crum Volunteer Monitoring Program	Chester Cr and Dutton Mill Rd	Ambient	March, April, August 2005	3
Chester Ridley Crum Volunteer Monitoring Program	White Clay at Strickersville	Ambient	March 2005	1
Chester Ridley Crum Volunteer Monitoring Program	West Branch Brandy at Modena	Ambient	March 2005	1
Chester Ridley Crum Volunteer Monitoring Program	EBDT	Ambient	March 2005	1
Chester Ridley Crum Volunteer Monitoring Program	Goose Creek and at Alumni Road (Cheyney stadium)	Ambient	March 2005	1
Chester Ridley Crum Volunteer Monitoring Program	Ridley Creek at Gradyville	Ambient	March 2005	1
Chester Ridley Crum Volunteer Monitoring Program	Ridley Creek and Waterville Road	Ambient	March 2005	1
<p>¹. Continuous data for temperature, pH, specific conductance, and dissolved oxygen is available from April 26, 2004 at Locksley Road Bridge.</p> <p>². Continuous data for temperature, pH, specific conductance, and dissolved oxygen is available from August 3-4, 2005 at the intersection of Route 926 and Goose Creek. In addition to this data, there is also a monthly sample for nitrate and total reactive phosphorous.</p>				

National Park Service

The National Park Service has conducted biological and chemical sampling as well as hydrological measurements at three sites in the Chester Creek watershed. Samples were conducted once in the morning and once in the afternoon on September 9, 1997. The sites are situated on Chester Creek and two of its tributaries (East Branch and West Branch Chester Creek). **Table 2-9** provides a description of the sampling location and information.

Table 2-9. Description of National Park Service Sampling		
Location Description	Sample Name	Data Collected
Along Creek Rd, South of Cheyney University	VAFO_CCHD_CREEK	Chemical
	VAFO_CHS_CREEK	Chemical, Biological, Hydrologic
Westtown Way between West Chester Pike and Westtown Rd	VAFO_CCHD_WEST	Chemical
	VAFO_CHS_WEST	Chemical, Biological, Hydrologic
In Newlin Park, near Baltimore Pike	VAFO_CCHD_NEWL	Chemical
	VAFO_CHS_NEWLIN	Chemical, Biological, Hydrologic

2.2.2 Stream Flow Data

The USGS collects daily stream flow and peak flow data at three locations in the Chester Creek watershed. The main flow gauge, USGS No. 01477000, is located in Chester Creek, near Chester, Pennsylvania and is the only station with continuous records that begins on October 1, 1931 and runs to the present day. For the purposes of this study, data from this gauge will be limited to the last 10 years in order to more appropriately reflect current development levels in the watershed. Based on this data, flows are typically greatest during spring and are lowest in July and August. The monthly flow averages for USGS Gauge No. 01477000 are presented in **Figure 2-5** including bars showing the range of the monthly averages. Peak flow monitoring data is also available for two sites in the watershed, one on East Branch Chester Creek and another on Chester Creek just after its confluence with East Branch Chester Creek.

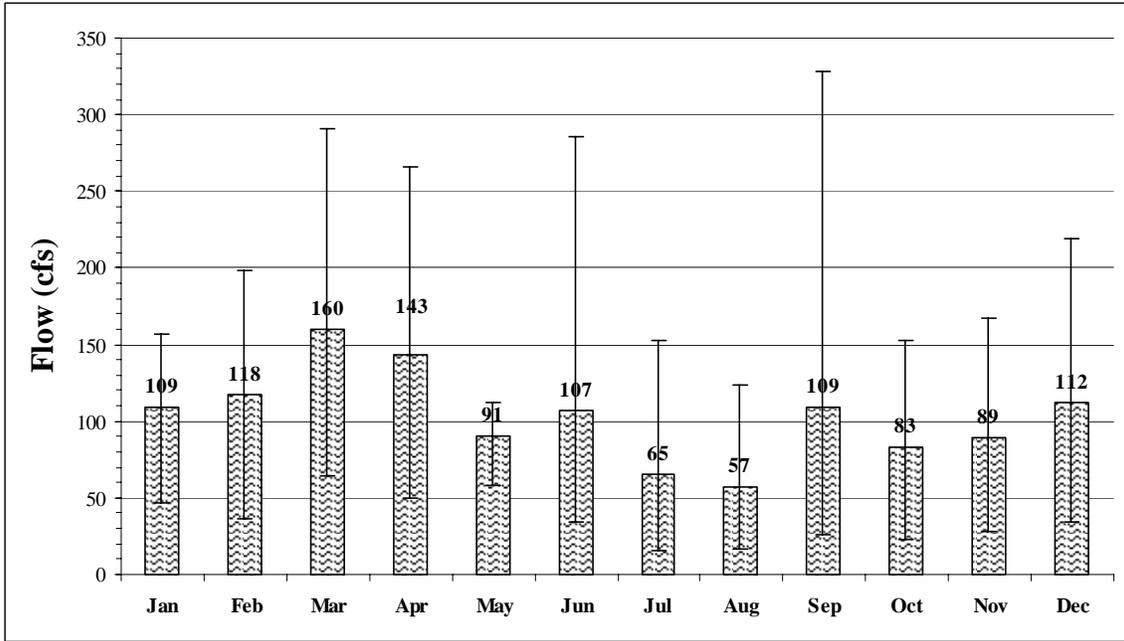


Figure 2-5: Monthly Flow Averages from 1998 through 2007 at USGS Station 01477000

Figure 2-6 depicts the yearly average flows from 1998 through 2007 at USGS Station 0147000 including the 10 year average flow (103 cfs based on flow from 1998 through 2007). The lowest flow occurred in 2002 and the highest flow year in 2003.

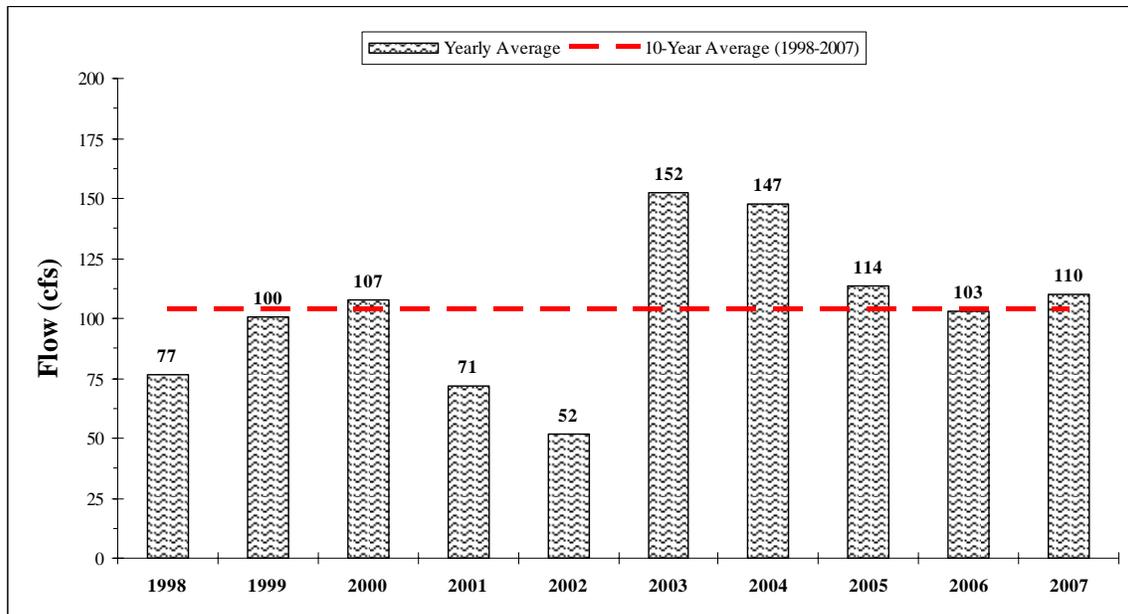


Figure 2-6: Yearly Average Flow by Year at the USGS Station 0147000

Critical periods in water quality often occur during short periods of one to two weeks. As a consequence, a weekly low-flow analysis was performed on the streamflow data at the USGS Station 0147000. This analysis consists of identifying the lowest weekly-average flow in Chester Creek for each year spanning the period of 1998 to 2007 and during the growing season (April through October). Table 2-10 shows the results of the analysis and indicates that the lowest weekly average flow occurred in the growing season of 2002. This lowest weekly average flow in 2004 is similar to the 7Q10 flow of 14.2 cfs that was calculated by USGS for the Chester Creek at Bridgeport¹.

Table 2-10. Lowest Weekly Average Flow Occurring ¹ each Year (1998 -2007)			
Year	Begin	End	Flow (cfs) at USGS Station 0147000
1998	28-Sep	4-Oct	25.00
1999	2-Aug	8-Aug	10.86
2000	4-Sep	10-Sep	35.14
2001	22-Oct	28-Oct	20.14
2002	12-Aug	18-Aug	6.44
2003	18-Aug	24-Aug	57.86
2004	6-Sep	12-Sep	54.00
2005	5-Sep	11-Sep	24.71
2006	14-Aug	20-Aug	29.86
2007	24-Sep	30-Sep	25.14

¹ during the growing season (April through October)

2.2.3 Permitted Discharge Facilities

Based on the PADEP’s Southeast Regional office, there are currently 32 NPDES-permitted discharge facilities in the watershed. The majority of these dischargers are sewage treatment plants; 7 of which are publicly-owned, municipal facilities and 18 are not publicly-owned facilities. The remaining significant dischargers are characterized as industrial waste (5), stormwater/industrial (1), or uncategorized (1). The permit number, type, permitted flow, receiving waterbody, and status of each of the facilities are presented in **Table 2-11** and their locations are presented in **Figure 2-7**.

¹ Low Flow Statistics for Pennsylvania Streams, developed by USGS for PADEP

Table 2-11. Facilities Holding Individual Permits in the Chester Creek Watershed

Permit Number	Discharger Name	Category	Design Flow (gpd)	Receiving Waterbody	Status
PA0027031	Goose Creek STP	Sewage Publicly Owned (Municipal)	1,672,000	Goose Creek	Active
PA0028584	West Goshen Sew Sys & STP	Sewage Publicly Owned (Municipal)	6,000,000	Chester Creek (Goose Creek)	Active
PA0031771	Westtown Twp STP	Sewage Publicly Owned (Municipal)	495,000	East Branch of Chester Creek	Active
PA0050652	Westtown School STP	Sewage Non-Publicly Owned (Non-Municipal)	30,000	East Branch of Chester Creek	Active
PA0051071	Schramm Inc	Industrial Waste	5,000	Goose Creek	Active
PA0031666	Concord Country Club	Sewage Non-Publicly Owned (Non-Municipal)	12,000	West Branch of Chester Creek	Active
PA0051161	Southco STP(Brandywine)	Sewage Non-Publicly Owned (Non-Municipal)	13,000	UT West Branch of Chester Creek	Active
PA0051756	State Farms Ins Ofc Bldg STP	Sewage Non-Publicly Owned (Non-Municipal)	25,000	UT West Branch of Chester Creek	Active
PA0050431	Concord Beverage LP	Industrial Waste	70,000	UT West Branch of Chester Creek	Active
PA0052744	Concordville Hotel STP	Sewage Non-Publicly Owned (Non-Municipal)	25,000	UT West Branch of Chester Creek	Active
PA0044474	Brinton Manor STP	Sewage Non-Publicly Owned (Non-Municipal)	13,000	West Branch of Chester Creek	Active
PA0054780	Riviera at Concord STP	Sewage Non-Publicly Owned (Non-Municipal)	63,500	Green Creek	Active
PA0031208	Garnet Valley HS STP	Sewage Non-Publicly Owned (Non-Municipal)	22,200	Green Creek	Active
PA0052230	Spring Hill Farm DEV STP	Sewage Non-Publicly Owned (Non-Municipal)	100,000	UT West Branch of Chester Creek	Active
PA0055212	Concord TWP SEW SYS & STP	Sewage Publicly Owned (Municipal)	1,800,000	West Branch of Chester Creek	Active
PA0031747	Glen Mills School STP	Sewage Non-Publicly Owned (Non-Municipal)	150,000	Chester Creek	Active
PA0029980	Sleighton Farm School STP	Sewage Non-Publicly Owned (Non-Municipal)	45,000	Rocky Run	Active
PA0056821	Malvern School of Glen Mills	Sewage Non-Publicly Owned (Non-Municipal)	2,500	Chester Creek	Active

Table 2-11. Facilities Holding Individual Permits in the Chester Creek Watershed

Permit Number	Discharger Name	Category	Design Flow (gpd)	Receiving Waterbody	Status
PA0030431	Fox Valley Comm. Services STP	Sewage Non-Publicly Owned (Non-Municipal)	74,000	West Branch of Chester Creek	Active
PA0050237	Walnut Hill Utility Co STP	Sewage Non-Publicly Owned (Non-Municipal)	150,000	Chester Creek	Active
PA0040576	Valley Brook APTs STP	Sewage Non-Publicly Owned (Non-Municipal)	72,000	West Branch of Chester Creek	Active
PA0051438	Westlake Plastics MFG PLT	Industrial Waste	200	Chester Creek	Active
PA0058769	Wawa Food MKT 133	Unavailable	4,500	UT to Rocky Creek	Active
PA0030970	Cheyney Univ of PA	Sewage Non-Publicly Owned (Non-Municipal)	270,000	East Branch of Chester Creek	Active
PA0053473	Thornbury TWP STP & SEW SYS	Sewage Publicly Owned (Municipal)	180,000	Chester Creek	Active
PA0027383	Southwest Delaware Cnty Muni Auth WWTP	Sewage Publicly Owned (Municipal)	6,500,000	Chester Creek and Baldwin Run	Active
PA0023949	Brookhaven Boro STP & SEW SYS	Sewage Publicly Owned (Municipal)	192,000	Chester Creek	Active
PA0052434	Coventry Crossing STP	Sewage Non-Publicly Owned (Non-Municipal)	40,000	UT to West Branch of Chester Creek	Active
PA0012467	Laurel Pipe Line (Boothwyn Sta)	Industrial Waste	--	Green Creek	Active
PA0035297	Sunoco (Twin Oaks Terminal IWSW)	Industrial Waste	--	UT to Baldwin Run	Active
PA0032301	Concord Industrial Park STP	Sewage Non-Publicly Owned (Non-Municipal)	20,000	West Branch of Chester Creek	Active
PA0013081	Kimberly Clark PA LLC	Industrial Waste	--	Chester Creek	Active
Discharge monitoring reports (DMR) for the permitted facilities were available from January 2000 to December 2004.					

In addition to these 32 facilities, there are currently 16 residencies that discharge in the Chester Creek watershed (**Table 2-12**).

Table 2-12. Residential Dischargers in the Chester Creek Watershed		
Permit Number	Receiving Waterbody	Design Flow (gpd)
PA0055816	UNT to Green Creek	500
PA0058432	UNT to WB Chester Creek-3G	500
PA0055778	UNT to WB Chester Creek	500
PA0057134	UNT to WB Chester Creek	500
PA0056197	UNT to WB Chester Creek-3G	500
PA0055514	UNT to WB Chester Creek	600
PA0054593	UNT to WB Chester Creek-3G	400
PA0058696	Chester Creek-3G	500
PA0056928	UNT to Chester Creek	500
PA0058351	UNT to WB Chester Creek-3G	500
PA0055760	UNT to WB Chester Creek	500
PA0053830	Goose Creek	500
PA0054615	UNT to Green Creek	400
PA0058149	UNT of Chester Creek	500
PA0053881	UNT to WB Chester Creek	400
PA0055786	UNT to WB Chester Creek-3G	400

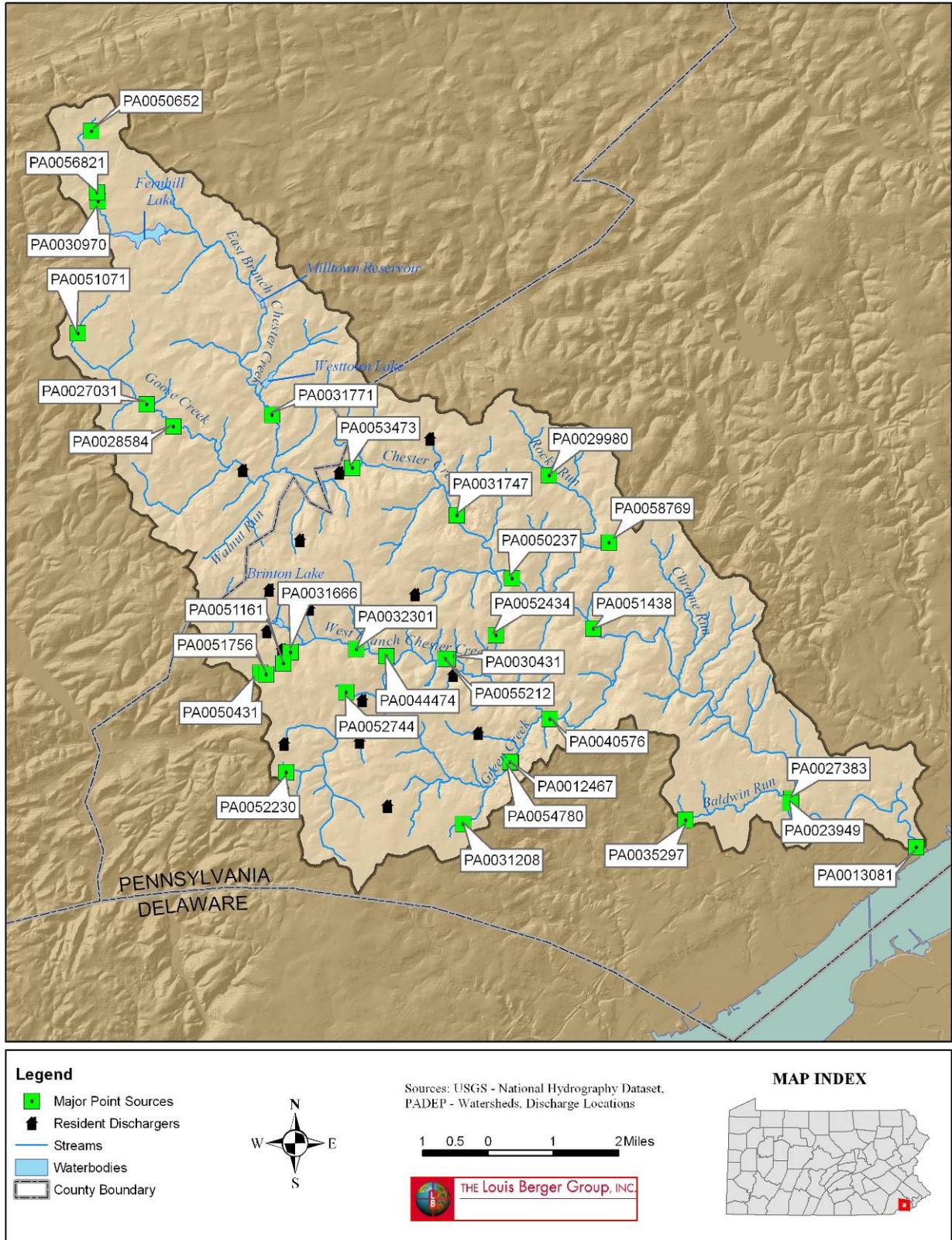


Figure 2-7: Locations of the Permitted Discharge Facilities in the Chester Creek Watershed

In addition to the individual permits presented above, 21 Municipal Separate Storm Sewer (MS4) permits have been issued to municipalities within the Chester Creek Watershed. **Table 2-13** lists all the MS4 permit holders with the area covered by each individual MS4. The MS4 areas were calculated using the US Census Urban Areas (2000). Combined, these MS4 permits cover approximately 84% of the Chester Creek watershed. **Figure 2-8** presents the major MS4 areas located within the Chester Creek watershed.

Table 2-13. MS4 Permits located within the Chester Creek Watershed	
MS4 Permit Holder	Acres
Aston Township	2,984
Bethel Township	933
Birmingham Township	15
Brookhaven Borough	649
Chadds Ford Township	133
Chester City	746
Chester Township	653
Chester Heights Borough	1,419
Concord Township	6,768
East Goshen Township	2,069
Edgmont Township	616
Middletown Township	5,494
Parkside Borough	49
Thornbury Township (Chester County)	929
Thornbury Township (Delaware County)	3,028
Upland Borough	432
Upper Chichester Township	229
West Chester Borough	312
West Goshen Township	4,575
West Whiteland Township	247
Westtown Township	3,333
Total	35,613

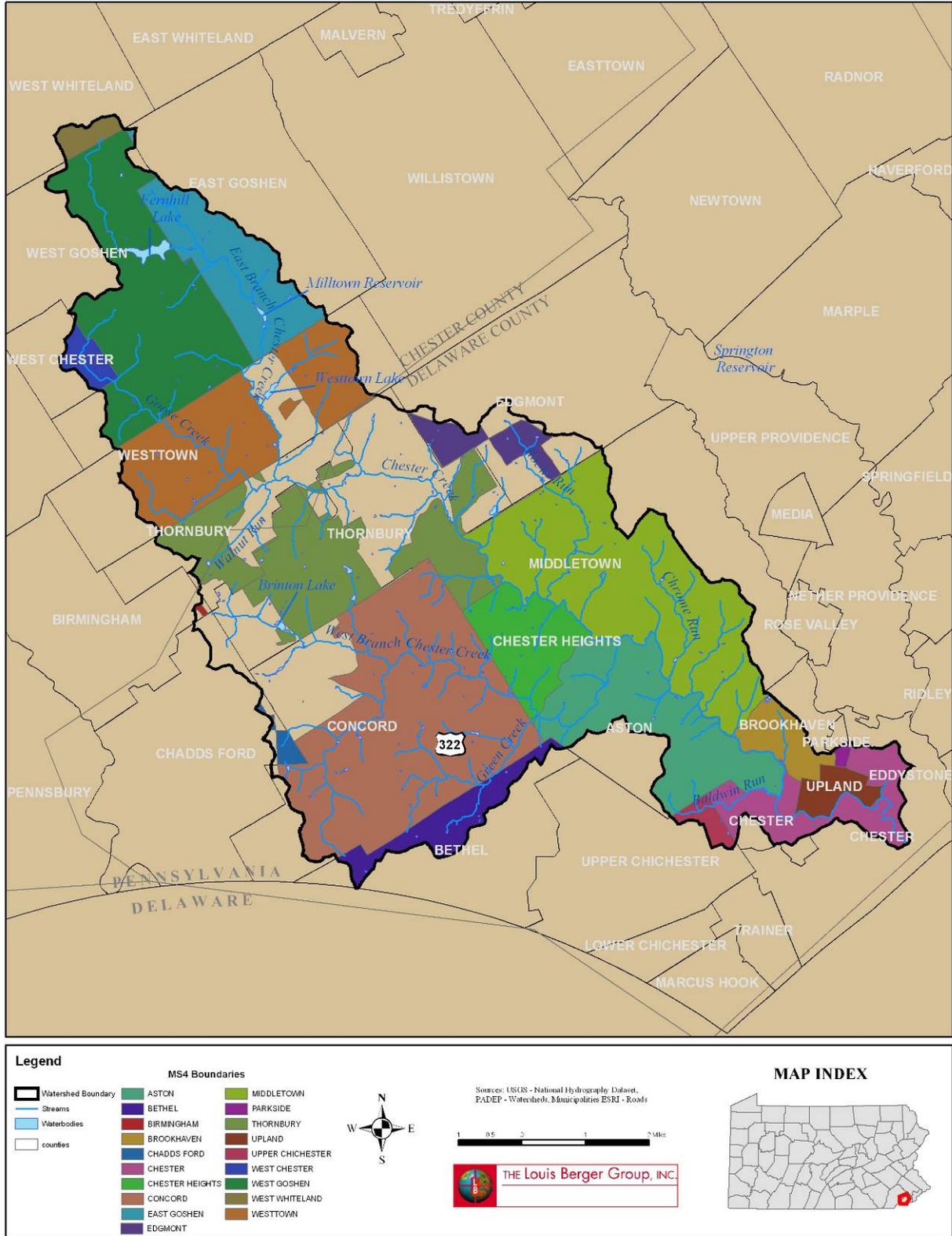


Figure 2-8: MS4 Boundaries in the Chester Creek Watershed

3.0 Monitoring Data Inventory and Analysis

Environmental monitoring efforts in the Chester Creek watershed include benthic community sampling and analysis, habitat condition assessments, ambient water quality sampling, and toxicity testing. Monitoring efforts have been conducted by agencies at the state and local levels, including the Pennsylvania Department of Environmental Protection (PADEP), the United States Geological Survey, and the National Park Service. Sampling has also been conducted by two community groups, the Chester Ridley Crum Volunteer Monitoring Program and the Chester Creek Watershed Association.

Figure 3-1 shows all of the monitoring locations in the Chester Creek watershed sampled between 1991 and 2002. **Figure 3-2** depicts the sample sites from surveys between September and October 2005. **Figure 3-3** shows the sample sites from surveys conducted in May and August 2006.

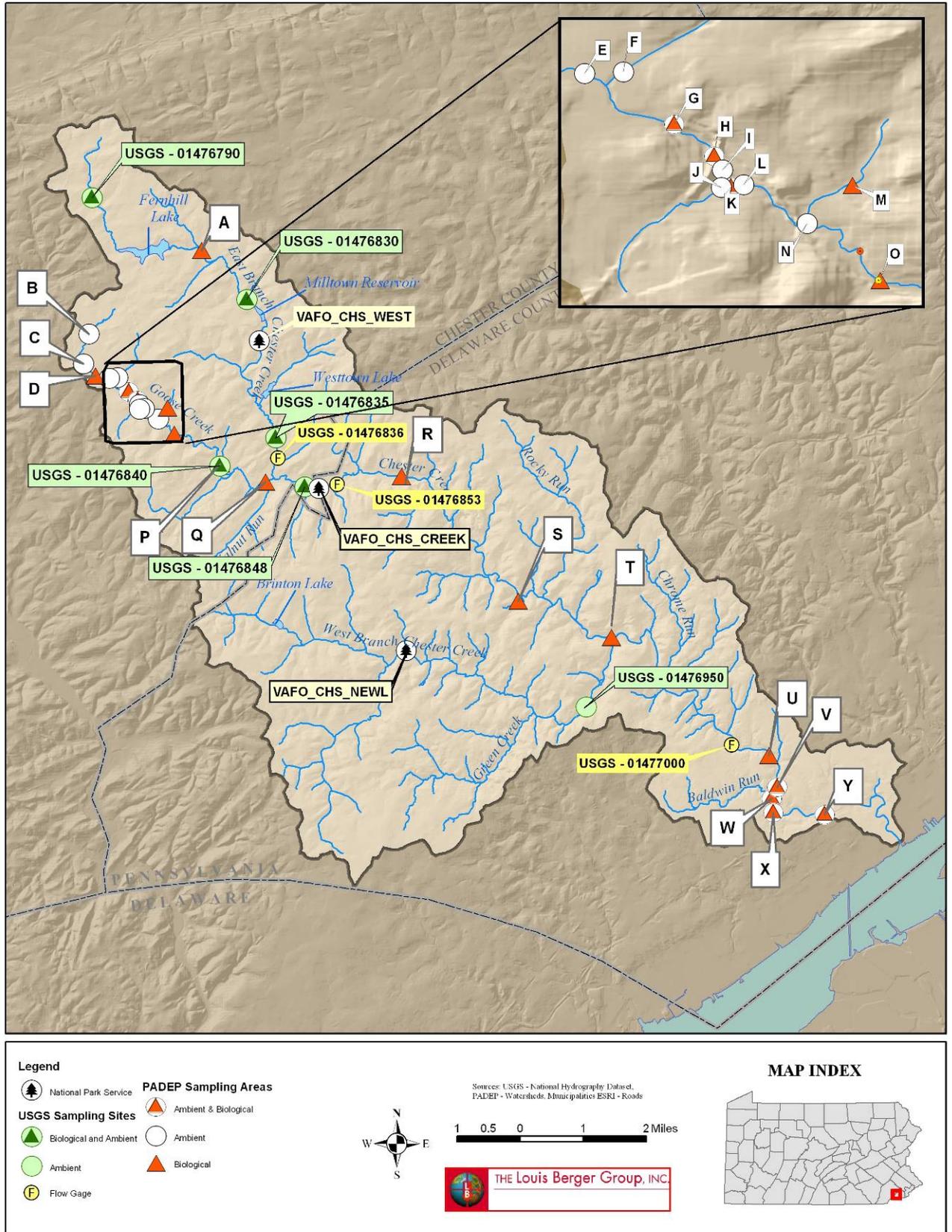


Figure 3-1: Monitoring Locations between 1991 and 2002

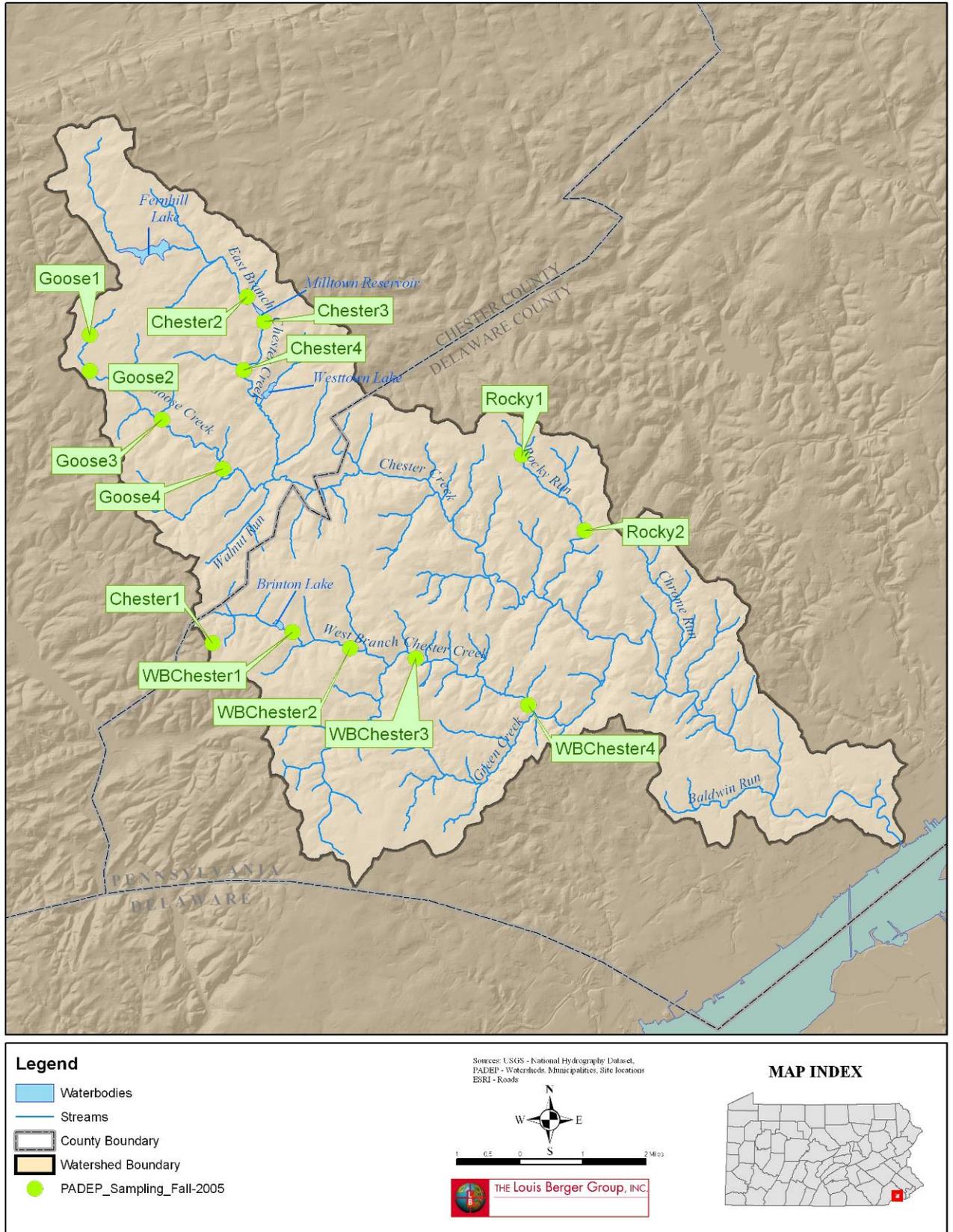


Figure 3-2: Monitoring Locations in Fall 2005

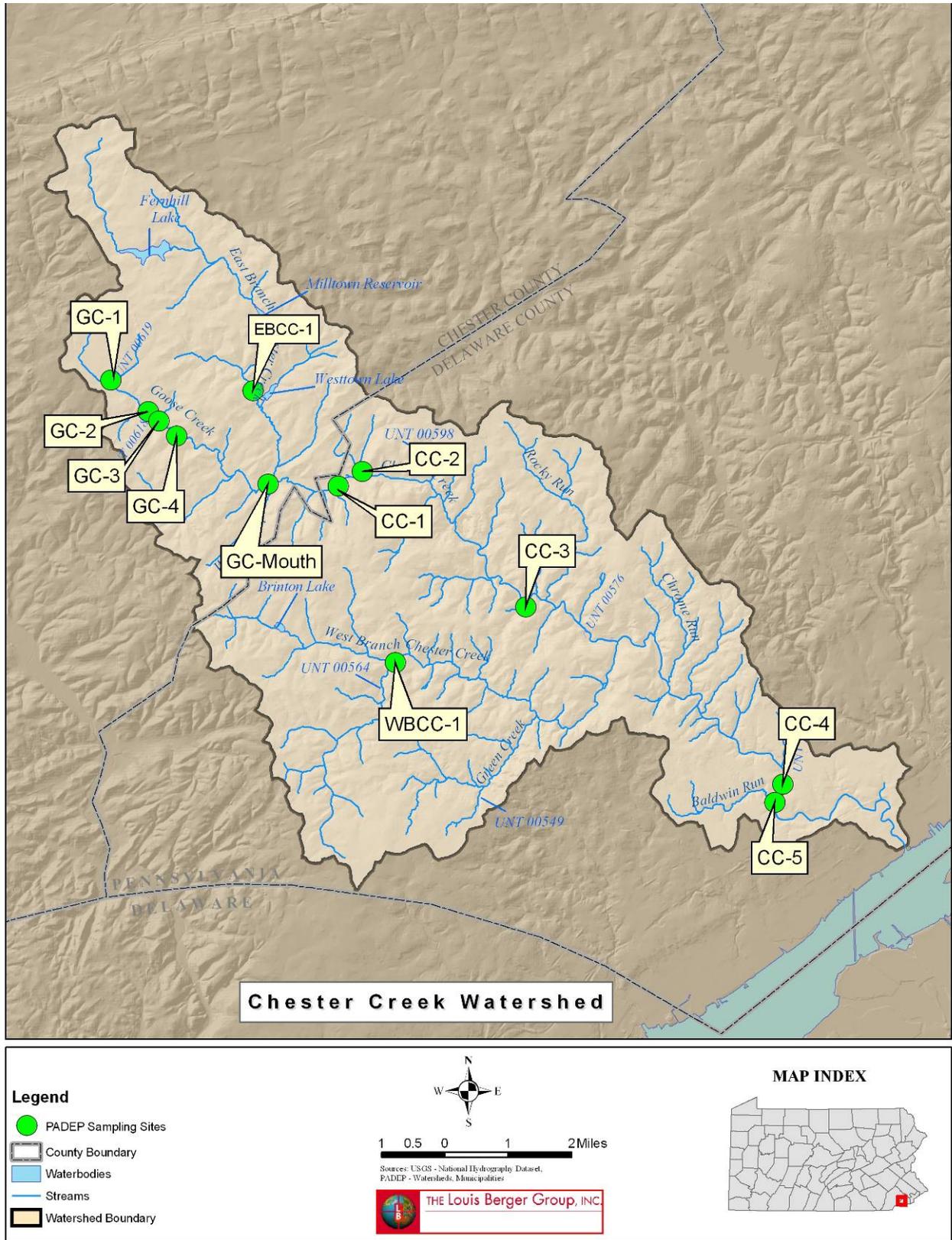


Figure 3-3: Location of PADEP Water Quality Stations in the Chester Creek Watershed

3.1 PADEP Data

The monitoring data provided by PADEP is presented in this section. Much of the initial data provided by PADEP was collected in the 1990s. More recent data were collected in 2005 and 2006. The subsequent discussion of the data will be divided into the following three sections:

1. PADEP monitoring data collected before 2005
2. PADEP monitoring data collected in 2005
3. PADEP monitoring data collected in 2006.

Included in each of these sections is a description of the data provided by PADEP (data inventory) and the corresponding analysis.

3.1.1 Monitoring Data Inventory and Analysis before 2005

Between 1991 and 2002, PADEP conducted monitoring at numerous locations in the watershed. In several cases, samples were collected multiple times in the same general areas between 1991 and 2002. The locations of these sampling sites were based on a physical description of the site (i.e. 30 meters from railroad trestle), measured page units on a USGS quad map (i.e. 12.10°N/10.08°W), or both. Sample locations were not formally numbered, and though samples were often conducted in the same general location, two or more samples taken from the same exact location were rare. Thus, the following tables listing sampling data for the PADEP have been grouped by sampling location. This spatial grouping of the data was applied to account for likely differences between sites that may be close, but are, for example, upstream and downstream of a tributary input and therefore not comparable. **Table 3-1** provides a description of each PADEP sampling area, the sampling period, and the types of data monitored.

In general, the PADEP sites monitored before 2005 were not evenly distributed throughout the watershed. These sampling efforts were focused primarily on Goose Creek, located in the northern portion of the watershed. In addition some sampling was conducted in the southern portion of the watershed near Chester Creek's confluence with the Delaware River (**Figure 3-1**).

Table 3-1. Summary of PADEP Monitoring Program

Stream	Sampling Area	Description	Sampling Date	# of Samples	Type of Data
East Branch Cheater Creek	A	East Branch of Chester Creek at Paoli Pike	1998	1	Biological, Habitat, Land Use
	B	At Montgomery Ave	2000	1	Organics
Goose Creek	C	Stream flow, mid-channel at E. Union St.	2000	1	Organics
	D	Goose Creek at Franklin St	1998	1	Biological, Habitat, Land Use
	E	Near Linden and Joseph Sts	1994, 2000	2	Biological, habitat, organics
	F	Tributary flow - west side of Bolmar St, North of Auto Park Blvd	2000	1	Organics
	G	Upstream from Goose Creek STP outfall	1991, 1994	2	Biological, habitat, Ambient
	H	Downstream Goose Creek STP outfall	1991	1	Biological, habitat, Ambient
	I	Samples less than 100 meters downstream from PA Route 202	1992, 1994	2	Organics, ambient
	J	Upstream of Chester Creek at trib	1994	1	Ambient
	K	Samples more than 100 meters downstream from PA Route 202	1991, 1992	3	Biological, Habitat, Ambient, Organics
	L	mid channel at Golf Course Drive	1994	1	Ambient
	M	Goose Creek at Concord Rd	1998	1	Biological, Habitat, Land Use
	N	At Railroad crossing upstream of West Goshen STP	1992, 1994, 1995	4	Biological, Habitat, Organics, Ambient
	O	Near Oakbourne Road	1994, 1995	2	Biological, habitat
	P	At Westbourne Road	1994	1	Biological, habitat
	Q	Goose Creek at Westtown-Thorton Road	1994, 1998	2	Biological, Habitat, Land Use
Chester Creek	R	Chester Creek at Locksley Rd	1998	1	Biological, Habitat, Land Use
	S	Chester Crk at Old Darlington Rd	1998	1	Biological, Habitat, Land Use
	T	Chester Creek at Parkmount Rd	1998	1	Biological, Habitat, Land Use
	U	Chester Creek at Bridgewater Rd	1998	1	Biological, Habitat, Land Use
	V	Chester Creek, Upstream from SW Del CO STP discharge	1997, 1998, 2002	4	Biological, habitat, Ambient
	W	Chester Creek, downstream from SW Del CO STP Outfall	1997, 1998, 2001, 2002	5	Biological, habitat, Ambient
	X	Chester Creek, downstream from SW Del CO STP outfall near the S&S Trailer Park	1998	1	Biological, habitat, Ambient
	Y	Chester Creek 550 meters downstream from Upland Road Bridge	1997	1	Biological, habitat, Ambient

3.1.1.1. Biological Monitoring Data

Benthic Macroinvertebrates

Biological monitoring data collected on Chester Creek was evaluated to assess the condition of the stream's benthic invertebrate communities. Biological assessments conducted by PADEP used different methods throughout the sampling period. **Table 3-2** shows 12 sampling areas within the watershed that were assessed using either a pollutant sensitivity ranking or a general assessment of the number of taxa found. A majority of the sampling was done on the segment of Goose Creek between the Goose Creek Sewage Treatment Plant (STP) and West Goshen Sewage Treatment Plant (sampling areas E, G, H, K, N). Sampling areas O, P, and Q are located downstream of the West Goshen STP. The remaining four sampling areas are located on Chester Creek, near the confluence with the Delaware River. Sampling areas W, X, and Y are downstream of the Brookhaven Boro wastewater treatment plant and Southwest Delaware County Municipal Authority wastewater treatment plant (WWTP).

The sensitivity ranking system categorized each invertebrate species as sensitive, moderately tolerant, or tolerant to pollution. The presence of taxa in the pollution-intolerant category would suggest that water quality conditions are generally good, whereas an overabundance of taxa in the pollution-tolerant category might indicate poor water quality conditions. The proportion of Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa found in the sample is another indicator for the presence of pollutant-intolerant species. Higher EPT values are a general sign of better water quality conditions. Lastly, the total number of taxa observed was also tabulated providing a measure of taxa richness. Communities with higher taxa richness are generally indicative of a healthy benthic community and better water quality conditions.

Table 3-2. Number of Invertebrate Taxa and their Representative Sensitivity Ratings

Stream	Area Designator	Sample Date	Sensitive	Moderately Tolerant	Pollution Tolerant	Total Number of EPT¹	Total Number of Taxa	Overall Rating
Goose Creek	E	Aug-94	-	-	-	1	16	Fair to Poor
	G	Feb-91	0	9	6	-	15	Poor
		Aug-94	-	-	-	0	5	Very Poor
	H	Feb-91	0	9	4	-	14	Poor
	K	Feb-91	0	5	7	-	11	Poor
	N	May-95	-	-	-	6	13	Fair to Poor
		Aug-94	-	-	-	2	12	Very Poor
	O	May-95	-	-	-	0	6	Fair to Poor
		August-94	-	-	-	2	13	Fair to Poor
	P	Aug-94	-	-	-	3	8	Fair to Poor
Q	Aug-94	-	-	-	3	13	Fair	
Chester Creek	V	Aug-97	0	11	3	3	14	Fair
		Sep-98	0	6	4	2	9	Fair to Poor
		Nov-02	2	8	3	4	13	Fair
	W	Aug-97	1	11	4	2	16	Fair
		Nov-01	0	7	6	-	13	NA ²
		Nov-02	1	7	4	3	12	Poor
	X	Sep-98	1	14	4	5	19	Fair
Y	Aug-97	0	10	6	2	16	Fair	

¹ If noted

²NA: Data records missing

In addition to the data presented above, PADEP conducted a monitoring survey in 1998 that covered sampling sites in Chester Creek using an alternative metric ranking system. **Table 3-3** shows biological assessment rankings for the remaining 9 stations. Sixteen metrics were examined including: family abundance, percentage of EPT taxa, Hilsenhoff index, and habitat assessment scores.

Table 3-3. Benthic Assessment Metrics Sampled at Sampling Areas in October 1998									
Metrics Examined	East Branch Chester Creek	Goose Creek				Chester Creek			
	A	B	D	M	Q	R	S	T	U
(1) Low Abundance			X	X					
(2) 7 or fewer Families in Collection			X	X	X	X			
(3) 3 or fewer mayfly individuals; exclude Baetidae, Caenidae, Siphonuridae	X		X	X	X	X			
(4) Stoneflies collectively present									
(5) Mayflies and caddisflies abundance; exclude baetidae, caenidae, siphonuridae, hydropsychidae, & polycentropodidae								X	X
(6) Jul-Sept: at least 4 EPT families w/Hilsenhoff of 4 or less Nov-May: at least 6								X	
(7) 4 or more families w/Hilsenhoff of 3 or less								X	
(8) 6 or more families w/Hilsenhoff of 4 or less								X	
(9) Dominant family w/Hilsenhoff of 4 or less			X						X
(10) Dominant family w/Hilsenhoff greater than 5				X					
(11) 7 or more families w/Hilsenhoff greater than 6 or more									
(12) Sample dominated by families w/mean Hilsenhoff of 5 or less	X	X				X	X	X	X
(13) Sample dominated by families w/mean Hilsenhoff of 6 or more			X	X					
(14) [#3 Riff/Run:embeddedness of #3 Glide/Pool: Substrate Character]+ #6 Sediment Deposition 24 or less (20 or less for warm water, low gradient streams)	X	X	X	X	X	X	X	X	
(15) #9 Condition of banks + #10 Bank vegetation 24 or less (20 or less for warm water, low gradient streams)		X	X	X	X	X	X	X	
(16) Total Habitat score 140 or less for forested, cold water, high gradient streams (120 or less for warm water, low gradient streams)		X	X	X	X	X			
Not Biologically Impaired								X	X
Biologically Impaired	X	X	X	X	X	X	X		

Benthic macroinvertebrate surveys conducted between 1994 and 2001 throughout the watershed showed that the majority of sampling areas are considered to have fair to poor or biologically impaired benthic communities. The following summary provides a brief accounting of the conditions and impairment causes at each sampling area with available biological data from the headwater tributaries in the northern portion of the watershed (sampling areas A through R) to the sampling areas on the segment of Chester Creek near the Delaware River (S, T, and U).

Sampling area A, located on a tributary to East Branch Chester Creek, a non-impaired segment, was noted as biologically impaired due to riffle embeddedness, a tolerant community, and a low percentage of EPT taxa. "Riffle embeddedness" is a description of the degree to which substrate (ie. rocks) is embedded in sediment, thereby reducing optimal habitat for sensitive macroinvertebrate species (ie. species of EPT). Sampling area D, the first area downstream of the Goose Creek STP, was considered to be biologically impaired due to a large percentage of tolerant species, riffle embeddedness, and poor bank stability. Further down stream from the Goose Creek STP, sampling area E was considered to have a fair to poor benthic community due to overall fair biodiversity and poor taxa abundance. Both sampling events taken at sampling area G, located just upstream of the Goose Creek STP were rated as poor to very poor. At this station, no EPT taxa or pollution-intolerant invertebrates were present in either sample. The benthic macroinvertebrate community was also considered poor at sampling area H located 30 meters downstream from Goose Creek STP. This community was assessed as poor due to an absence of pollution-intolerant taxa and the dominance of tolerant taxa.

Sampling area O, located on Goose Creek near Oakbourne Road was monitored in August 1994 and May 1995. In 1994 two EPT taxa were found, but the majority of taxa were highly tolerant to pollution. The sample collected in May 1995 showed a similar benthic community composition where the most abundant species present were midges and there were very few sensitive species in the sample. Sampling area P, located on Westbourne Road on Goose Creek was also considered fair to poor due to a dominance of tolerant organisms. Sampling area Q was also sampled twice, once in August 1994 and

once in October 1998. Both samples collected were considered impaired due to a low diversity, low EPT, riffle embeddedness, and eroded banks.

The most upstream biological monitoring station located on the Chester Creek is sampling area R which was sampled in October 1998 near Locksley Road. This sample was considered biologically impaired due to a low biodiversity, riffle embeddedness, and a poor habitat score. Located directly downstream near Old Darlington Road, sampling area S was also sampled once in October 1998. This station was also considered impaired due to a composition of primarily tolerant species, riffle embeddedness, and a poor overall habitat score. Sampling area V, located upstream of the Southwest Delaware County Municipal Authority WWTP, was sampled in 1997, 1998, and 2002; two out of three samples were considered to have a fair benthic community. However, the most abundant species within these samples were pollution-tolerant. Sampling area W, located just downstream of the Southwest Delaware County Municipal Authority WWTP discharge was considered to have a fair benthic community in 1997 and was considered to have a poor community in 2002. In 2002, the biologist notes state that the benthic community was negatively impacted, potentially by the discharge from the facility. The most downstream biomonitoring stations in the Chester Creek watershed are sampling areas X and Y which were both assessed as fair.

Fish Sampling

Fish sampling was conducted on August 3 and 8, 1994 at five sites along Goose Creek (**Table 3-4**). A total of nine different fish species were collected at these locations. Four of these species are considered to have intermediate tolerance to pollution, four species are considered to be tolerant, and one species is considered to be intolerant (EPA, 2002). The most commonly occurring species at sampling stations were American eels, blacknose dace, and banded killifish.

Sample areas E and G are located on the segment of Goose Creek between the Goose Creek and West Goshen STPs. Samples collected at these locations were primarily composed of species with intermediate tolerance and species tolerant to pollution. Sampling area N is located just before the West Goshen STP, and sampling areas P and Q

are located downstream from the facility. Samples collected at sampling areas N, P, and Q tended to have a greater proportion of species with intermediate tolerance to pollution. During this sampling event, Site P was the only station to record a fish species considered intolerant to pollution.

Species	Pollution Tolerance Level*	Sampling Area				
		E	G	N	P	Q
American eel, <i>Anguilla rostrata</i>	Intermediate	R		R	R	P
Common Shinner, <i>Luxilus cornutus</i>	Intermediate					P
Blacknose dace, <i>Rhinichthys atratulus</i>	Tolerant	C		R	R	P
Creek chub, <i>Semotilus atromaculatus</i>	Tolerant	C	P			R
White sucker, <i>Catostomus commersoni</i>	Tolerant					A
Banded killifish, <i>Fundulus diaphanus</i>	Tolerant		R	P	P	P
Pimkinseed, <i>Lepomis gibbosus</i>	Intermediate			P	R	
Largemouth bass, <i>Micropterus salmoides</i>	Intermediate			R		
Tessellated darter, <i>Etheostoma olmstedi</i>	Intolerant				R	
Total Number of Species		3	2	5	5	6
Total Number of Individuals		73	6	21	NA	NA
Overall Site Rating		Fair	Very Poor	Poor	Poor	Fair

R-Rare (1-2 individuals), P-Present (3-24 individuals), C-Common (25-99 individuals), A-Abundant (>100 individuals). NA: Not Available

* (Source: EPA, 2002)

Habitat Assessment Scores

A suite of habitat variables were visually inspected at stations throughout the watershed during biological monitoring events. Habitat parameters that were examined at 12 sites within the watershed include channel alteration, substrate embeddedness, riffle frequency, channel flow and velocity, stream bank stability and vegetation, and riparian zone vegetation. The bank and instream composition as well as biologist comments on the habitat are shown in **Table 3-5**.

Table 3-5 shows that habitat assessments indicated the majority of stations were shaded with eroded banks. Biologists’ scores for habitat metrics such as riparian zone vegetation, riffle frequency, and bank stabilization and protection were, on average, low at the majority of stations. Also, the biologist comments in **Table 3-5** documented presence of filamentous algae at some stations.

Table 3-5. Steam Habitat Assessment

Stream	Sampling Area	Sample Date	Bank Composition (%)		Instream Channel Composition (%)					Comments
			Shaded	Eroded	Boulder	Cobble	Gravel	Sand	Silt	
Goose Creek	E	Aug-94	70%	80%	5%	15%	40%	30%	-	Sparse trees & moderate shrubs. Sparse Elodea sp and water cress
	G	Feb-91	70%	70%	50%	20%	15%	15%	-	Steep gradient, foam present, heavy growth of filamentous algae, landfill residue
		Aug-94	70%	80%	30%	30%	20%	20%	-	Moderate trees, dense shrubs/ Dead epilithic periphyton on substrate. Oily sheen and odor.
	H	Feb-91	70%	90%	20%	40%	20%	20%	-	Filamentous algae less prevalent, foam and sludge downstream of the Goose Creek STP outfall, tannic color
	K	Feb-91	50%	75%	10%	40%	40%	10%	-	Seeps from abandoned landfill entering stream, storm sewer discharge from industrial park.
	N	May-95	80%	65%	5%	5%	15%	70%	5%	None
		Aug-94	60%	30%	10%	20%	30%	30%	10%	Moderate trees, dense shrubs, grass lawn brown filamentous periphyton dense on substrate
	O	May-95	95%	30%	20%	25%	15%	35%	5%	None
		Aug-94	70%	30%	10%	20%	30%	40%	-	Moderately embedded. Moderate trees and dense shrubs. Velocity of stream high and channel full; from West Goshen STP. Thin, green periphytic coating present on stream substrate
	P	Aug-94	30%	30%	10%	20%	30%	20%	20%	Sparse trees & dense shrubs
Q	Aug-94	50%	50%	20%	20%	10%	30%	20%	Sparse trees & dense shrubs	
Chester Creek	V	Aug-97	60%	50%	5%	10%	20%	60%	5%	None
		Aug-98	60%	50%	10%	15%	15%	50%	10%	None
		Oct-02	-	50%	-	35%	30%	30%	-	None
	W	Aug-97	80%	40%	-	-	-	-	-	None
		Aug-98	85%	75%	5%	15%	15%	50%	5%	None
		Nov-01	20%	30%	5%	20%	20%	50%	5%	None
		Oct-02	-	30%	-	20%	50%	25%	-	None
X	Aug-98	60%	85%	10%	40%	25%	15%	10%	None	

Table 3-5. Steam Habitat Assessment

Stream	Sampling Area	Sample Date	Bank Composition (%)		Instream Channel Composition (%)					Comments
			Shaded	Eroded	Boulder	Cobble	Gravel	Sand	Silt	
Y		Aug-97	50%	30%	-	-	-	-	-	None

Habitat assessments were also conducted at 9 stations in October 1998 using a different metric system that scored thirteen habitat parameters including: instream cover, embeddedness, sediment deposition, vegetation composition, and channel alteration (Table 3-6). Each of the 13 parameters examined was scored out of a possible 20 points and results were combined to determine an overall rating. Based on this survey, all sites were considered impaired habitats, with the poorest habitat generally found in the headwaters of Goose Creek.

Table 3-6. Habitat Assessment Scores based on a Total of 240 points at Stations Sampled in October 1998

Stream	East Branch Chester Creek	Goose Creek				Chester Creek			
Sampling Area	A	B	D	M	Q	R	S	T	U
(1) Instream Cover	7	8	11	9	8	15	10	12	15
(2) Epifaunal Substrate	11	8	7	4	12	7	11	15	13
(3) Embeddedness	9	3	7	2	6	2	7	9	10
(4) Velocity/Depth Regimes	16	10	15	13	16	16	16	17	18
(5) Channel Alterations	12	15	4	4	11	11	16	11	12
(6) Sediment Deposition	7	6	10	10	7	8	8	15	15
(7) Frequency of Riffles	7	8	11	12	10	15	15	13	16
(8) Channel Flow Status	14	15	15	16	16	15	15	16	15
(9) Condition of Banks	11	6	7	11	10	5	11	11	15
(10) Bank Vegetation	13	6	10	7	11	5	9	13	16
(11) Grazing or Disruptive	5	13	3	10	10	16	18	9	8
(12) Riparian Vegetation	3	15	1	6	6	15	18	3	3
(13) Total (Out of 260)	115	113	101	104	123	130	154	144	156
Impaired Habitat (Yes or No)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

3.1.1.2. Ambient Water Quality Monitoring Data

There are 15 PADEP ambient water quality sampling areas located in the Chester Creek watershed. The sampling area, location description, and dates sampled are presented in **Table 3-7**.

Table 3-7. Ambient Water Quality Monitoring Stations			
Stream	Area	Description	Sample Dates
Goose Creek	B	Stream flow, mid-channel at Montgomery Ave	06/05/00
	C	Stream flow, mid-channel at E, Union St	06/05/00
	E	Stream flow, mid-channel at end of Joseph Alley	06/05/00
	F	Stream flow, mid-channel at end of Joseph Alley	06/05/00
	G	30 miles upstream from Goose Creek STP outfall	02/14/91
	H	30 meters downstream from Goose Creek STP outfall	02/14/91
	I	2m downstream of Us Route 202	4/1/1992, 11/01/94
	J	~15 ft upstream of Chester Creek	11/01/94
	K	240m downstream of US Route 202	4/1/1992, 02/14/91
	L	Mid channel at Golf Course Drive	11/01/94
	N	20m upstream of railroad crossing	4/1/1992, 11/01/1994
Chester Creek	V	Chester Creek, approx 80 meters upstream from SW Delaware County STP discharge	8/27/1997, 09/08/98, 10/31/02, 11/01/02
	W	Chester Creek approximately 100 meters downstream from SW Del CO Municipal Authority STP Outfall	8/27/1997, 09/08/98, 09/08/98
	Y	Chester Creek 550 meters downstream from Upland Road Bridge	08/27/97
	X	Chester Creek 600 meters downstream from SW Del CO STP outfall near the S&S Trailer Park	09/08/98

Of the water quality monitoring stations located in the watershed, 11 are located on Goose Creek (sampling areas B through N), and 4 (sampling areas V through X) are located on the mainstem of Chester Creek (**Tables 3-7**). The data from these sampling areas was collected between 1991 and 2002. It should be noted that water quality sampling was only conducted in the upper section (upstream of the USGS station 014776860) and lower section (downstream of the USGS flow station 01477000) of the Chester Creek watershed. These sampling events only covered about one-third of the Chester Creek watershed. Moreover, water quality samples in the upper section were collected between 1991 and 1994, while sampling was conducted in the lower portion of the Creek between 1997 and 2002. A bulleted summary of the data derived from all in-stream monitoring on Goose Creek and Chester Creek is provided below:

- Alkalinity, chloride, color, pH, and temperature were in compliance with the criteria.
- Field dissolved oxygen values were consistently above the minimum standard, except for one occasion in sampling area K in April of 1992 (2 mg/L).
- Total residual chlorine values exceeded the criterion (1 hour average of 0.019 mg/L) for all measured values (range: 0.02 - 0.80 mg/L).
- More than 65 percent of the observed values of BOD₅ and nitrogen inhibited BOD₅ (NIBOD₅) at most sampling stations were above 2 mg/L.
- Total nitrogen concentrations ranged between 3.2 and 83.1 mg/L. Total nitrogen was dominated by nitrate for all samples except for three occasions, during which ammonia dominated (within sampling areas K and N).
- Ammonia concentrations exceeded the standard on eleven occasions. The majority of the exceedances (nine out of eleven) occurred within the upper section of the Chester Creek watershed.
- NO_x-N (NO₂-N + NO₃-N) values exceeded the maximum standard on two occasions (at K in 02/14/1991 at 33.74 mg/L and at H in 02/14/1991 at 37.45 mg/L).
- Total phosphorus values ranged between 0.03 and 4.08 mg/L (sampling areas J and H, respectively) with more than 60 percent of the samples (23) greater than 0.5 mg/L.
- Compared to other sampling stations, conductivity levels in sampling areas H and K showed higher levels (range: 1300 - 1500 µmMhos/cm). The conductivity levels corresponded to elevated values of nitrogen in forms of NO_x-N (range: 33.7 – 37.4 mg/L) and NH₃-N (70 mg/L).
- Sulfate exceeded the maximum standard on two occasions (at K in 02/14/1991 at 372 mg/L and at H in 02/14/1991 at 394 mg/L).
- Total recoverable manganese exceeded the maximum standard on two occasions (at J in April 1992 at 1.59 mg/L and at N in April of 1992 at 2.07 mg/L).

- Total recoverable iron exceeded the maximum standard on four occasions the 30-day average standard of 1.5 mg/L (at J in April of 1992 at 7.92 mg/L, at three sites in sampling area K in April of 1992 at 65.5 mg/L, 26.8 mg/L and 29.9 mg/L, and at N in April of 1992 at 29.9 mg/L).
- Oil and grease values ranged between 1 and 110 mg/L.
- Phenolics (Phenol) exceeded the maximum standard on two occasions (at two sites in sampling area K in 04/01/1992 at 12.5 µg/L and 17.5 µg/L).
- Fecal coliform and total coliform ranged between 20 and 120,000 col/100ml and between and 80 to 130,000 col/100ml.

3.1.1.3. Metals Data

Total metals data collected within the watershed included cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc. All available total metals data collected were analyzed to determine whether the examined parameters complied with Pennsylvania’s established water quality standards for Criteria Continuous Concentration (CCC) and Criteria Maximum Concentration (CMC). Hardness concentrations were not available at four sampling stations (G, H, K, and X) and were estimated based on averages of stations in the vicinity and similar sampling times (see footnotes on **Table 3-9**).

For the fish and aquatic life criteria, exceedances were found for cadmium, copper, lead, mercury, and nickel. The copper standard was most frequently exceeded. The majority of the exceedances were identified at stations located in the upper section of the Chester Creek watershed and occurred under high flow conditions (**Tables 3-8 and 3-9**). Measurements from the water quality station at N₁ exceeded all four identified metals. It should be noted that many of the observed metal values were measurements that were below the detection limit. If these additional measurements were analyzed for compliance with PADEP standards, there would be an additional six exceedances of the CCC criterion for cadmium, no CMC exceedance for cadmium, and one CCC exceedance for lead. This data will be shared with PADEP as part of ongoing assessment and listing processes.

Only mercury values exceeded the human health criteria (four out of fourteen samples collected in sampling areas I, K, and N). If all reported measurements below the detection limit were analyzed, then there would be an additional ten exceedances.

Table 3-8. Number of Exceedances of Total Recoverable Metals at PADEP Stations for Fish and Aquatic Criteria									
	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Zinc
CCC ¹	1/20	0/20	8/22	1/17	2/14	1/20	0/4	-*	0/22
CMC ¹	0/20	0/20	3/22	0/17	0/14	0/20	-*	0/4	0/22
¹ Number of exceedances to number of observed metals									
* No standard is defined									

Table 3-9. Metal Exceedances for Chester Creek at PADEP stations for Fish and Aquatic Criteria

		Tot. Cd		Tot. Cr		Tot. Cu		Tot. Pb		Tot. Hg		Tot. Ni		Tot. Se		Tot. Ag		Tot. Zn	
Stream	Area	CCC	CMC																
Goose Creek	G*					√													
	H*					√	√												
	I ₁					√													
	I ₂					√													
	J																		
	K ₁ **					√	√												
	K ₂																		
	K ₃									√									
	L					√													
	N ₁	√				√		√		√		√							
	N ₂																		
Chester Creek	V ₁																		
	V ₂																		
	V ₃																		
	V ₄																		
	V ₅																		
	W ₁																		
	W ₂ ¹																		
	W ₃ ²																		
	W ₄ ²																		
	W ₅																		
	Y																		
	X***					√	√												

* hardness were estimated (here:200 mg/L) based on an average of two measurements at sampling area J
 ** hardness were estimated (here:378 mg/L) based on an average of two measurements at sampling area K, and L
 *** hardness were estimated (here:130 mg/L) based on an average of four measurements at sampling area W

3.1.1.4. Organic Data

Organic compounds monitored in the Chester Creek watershed included: CN (Free HBG), Benzene, Bis (2-ethylhexyl) phthalate, Bromoform, Carbon, Tetrachloride Chlorobenzene, Chloroform 1,1-Dichloroethene, cis-1,3-Dichloropropene, trans-1,3-Dichloropropene, m-Xylene Methyl Bromide (Bromomethane), Methyl Ethyl Ketone, Methyl Isobutyl Ketone, Methylene Chloride Naphthalene, o-Xylenes Tetrachloroethylene, Toluene, Trichloroethylene, 1,1,2,2-Tetrachloroethane, 1,1,2-Trichloroethane, 1,4-Dichlorobenzene, 1,3-Dichlorobenzene, Acetone, Ethyl Benzene, and Hexachlorobutadiene Bis (2-ethylhexyl) phthalate. All available organic compound data collected in the Chester Creek watershed were analyzed to determine whether the samples complied with Pennsylvania's established water quality standards. The majority of dissolved organic parameters measured were below detection limits.

- Based on the analysis, there were no exceedances of the fish and aquatic life criteria. However, there were exceedances of the human health criteria. The following summarizes the human health criteria exceedances:
- One out of five values exceeded the methylene chloride criterion (Sampling area I).
- One out of five values exceeded the benzene criterion (Sampling area I₁).
- Four out of five values exceeded the trichloroethylene criterion (Sampling areas B, C, E, and I).
- Six out of eight values exceeded the 1,1,2,2-Tetrachloroethane criterion (Sampling areas B, F, I, L, and N).
- One out of five values exceeded the 1,1,2-Trichloroethane criterion (Sample area I).
- All values exceeded the Bis (2-ethylhexyl) phthalate criterion (Sampling area I).
- All values exceeded the 1,1,1,2-Tetrachloroethane criterion (Sampling areas B, C, E, F, I).

3.1.1.5. Assessment of the Potential Impact of Two Sewage Treatment Plants

PADEP conducted two assessments of the potential impact of two major wastewater treatment facilities on Chester Creek. Water quality samples were taken upstream and downstream from the wastewater treatment facilities, and from the outfall of the wastewater treatment facilities.

Located on the most upstream section of Goose Creek, the Goose Creek STP (PA0027031) was the first wastewater treatment facility to be assessed. Based on one sampling survey in February 14, 1991, the impact of the Goose Creek STP effluent on the stream was found generally significant. In particular, nutrients (nitrate: 37.4 mg/L and total phosphorus: 4.08 mg/L), BOD₅ (14.8 mg/L), and metals (Copper: 81 µg/L and zinc: 140 µg/L) were considerably elevated after the effluent. The elevated effluent discharge of copper caused an additional exceedance of the CMC criterion for copper. Also, sulfate and total alkalinity concentrations were affected by the effluent; sulfate concentration increased more than 10 times and alkalinity decreased by almost 50 percent after the effluent (Table 3-10).

Parameter	Unit	Upstream (sampling area G)	STP	Downstream (sampling area H)
pH	std units	7.66	6.02	6.62
Spec. Cond.	uMHOS/cm	269	2330	1500
Tot Alk., CaCO₃	mg/L	70.00	19.00	42.00
BOD₅	mg/L	3.20	24.00	14.80
NO₃-N	mg/L	2.85	68.40	37.40
Phos, Total	mg/L	0.08	7.59	4.08
S₀₄	µg/L	34.00	696.00	394.00
Copper, total	µg/L	19.00	88.00	81.00
Iron, total	µg/L	616.00	341.00	478.00
Manganese, total	µg/L	115.00	41.00	74.00
Zinc, total	µg/L	60.00	205.00	140.00

Located in the lower section of the Chester Creek watershed, the Southwest Delaware County Municipal Authority (SW Del Co) WWTP (PA027383) is the largest municipal discharger in the watershed and the second facility to be assessed. The impact of SW Del Co STP on the stream was monitored on four occasions between 1997 and 2002. The greatest impact of SW Del Co STP on water quality downstream of the effluent was found for nitrogen (ammonia, nitrate, and TN), total phosphorus and nitrogen inhibited BOD₅ (NIBOD₅) (**Figure 3-4**). For metals, the SW Del Co STP caused general impacts to the downstream station but never caused any exceedance of the CCC and CMC criteria.

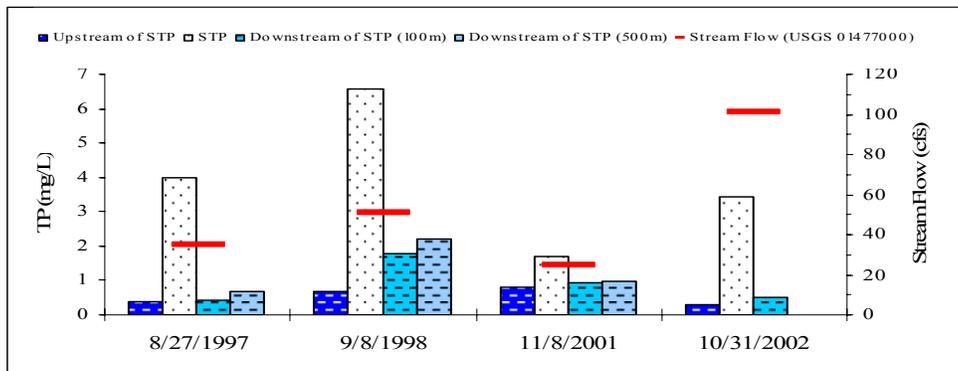
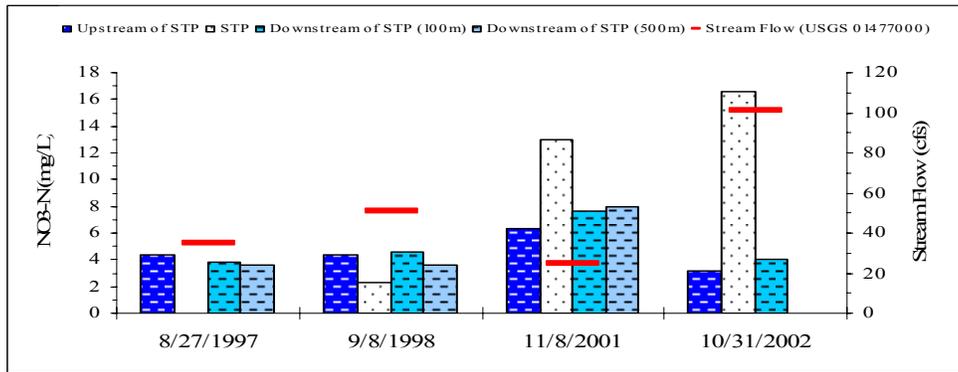
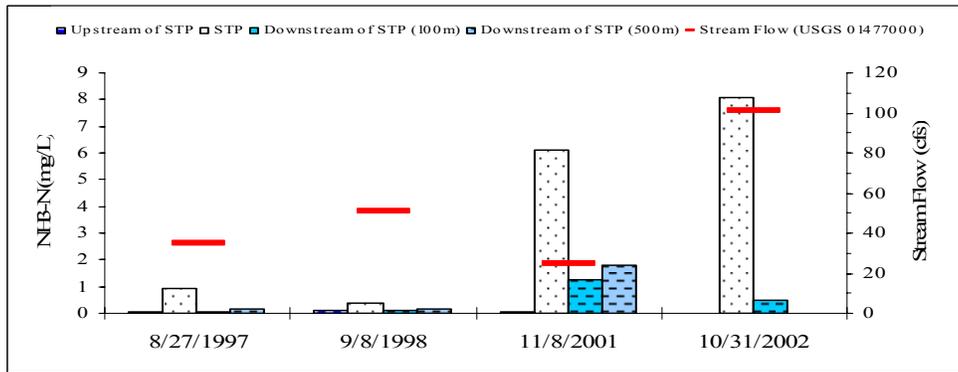
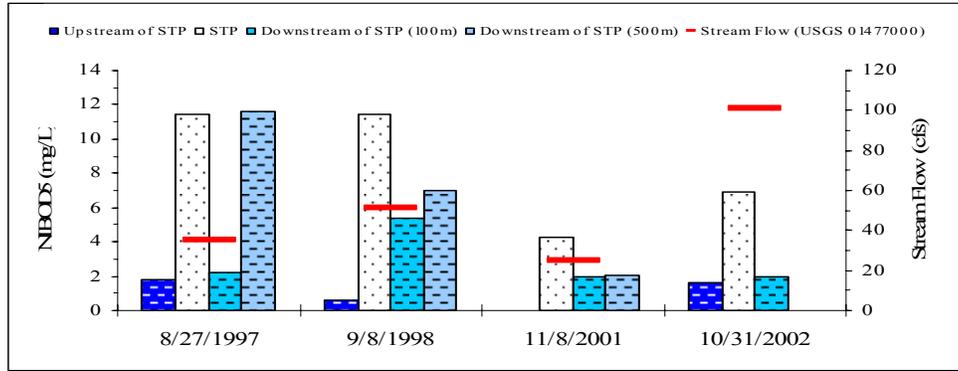


Figure 3-4: Impact of the SW Del Co STP on Chester Creek

3.1.2 Monitoring Data Inventory and Analysis Fall 2005

3.1.2.1 Ambient Water Quality

Between September 28th and October 21st of 2005, fourteen monitoring sites in the watershed were sampled once by PADEP (**Figure 3-2**). These sites were located based on latitude and longitude measurements and sampled for field parameters (temperature, dissolved oxygen, specific conductivity, and pH).

Four stations were located on the Goose Creek (Goose1 through Goose4), four on the East Branch Chester Creek (Chester2 through Chester4), two were located on Rocky Run (Rocky1 and Rocky2), and four on West Branch Chester Creek (WBChester1 through WBChester4). Samples were analyzed to determine whether the examined parameters complied with Pennsylvania's established water quality standards. All measured parameters were in compliance with the criteria. Specific conductivity levels ranged between 571 and 741 $\mu\text{S}/\text{cm}$ and were higher than levels measured at the tributaries (range: 278 to 417 $\mu\text{S}/\text{cm}$).

3.1.3 Monitoring Data Inventory and Analysis in 2006

3.1.3.1. Ambient Water Quality

Water quality samples were collected on May 24th and August 1st of 2006 at eleven stations (**Figure 3-3**) in the Chester Creek watershed. Of the eleven stations, four were located on Goose Creek; five were located on Chester Creek; one on East Branch Chester Creek; and one on West Branch Chester Creek. The following parameters were measured at each of the stations: temperature, specific conductivity, dissolved oxygen (DO), pH, alkalinity, total dissolved solids (TDS), total suspended solids (TSS), carbonaceous BOD₅ (CBOD₅), carbonaceous BOD₂₀ (CBOD₂₀), total phosphorus (TP), dissolved P, total ortho-phosphorus, dissolved ortho-phosphorus, total nitrogen (TN), nitrate, nitrite, and ammonia. In addition, flow was measured at each station.

Figure 3-5 through **Figure 3-7** shows the measured range of TP, TN, and nitrate at each water quality station corresponding to the river miles. In addition, these figures show the impact of the three largest wastewater treatment facilities in the watershed on water quality:

- Goose Creek WWTP (PA0027031) located between water quality stations GC1 and GC2,
- West Goshen Township Sewer Authority (PA0028584) located between water quality stations GC3 and GC4,
- SW Delaware County Municipal Authority DMR (PA0027383) located between water quality stations CC4 and CC5.

A summary of the measured water quality results is provided below:

- DO, pH, and alkalinity values were in compliance with PA standards.
- TDS exceeded the PA standard once at station GC-3 (Goose Creek).
- TSS ranged between <2 and 12 mg/L.
- CBOD₅ concentrations ranged between 1.0 and 2.3 mg/L.
- CBOD₂₀ concentrations ranged between 0.9 and 11.2 mg/L.

- TP levels were highest in Goose Creek (Range: 0.038 – 2.402 mg/L) with the highest concentration found downstream of the discharger Goose Creek WWTP (PA0027031). In Chester Creek, TP ranged between 0.856 and 0.373 mg/L decreasing downstream. At stations on West Branch Chester Creek and East Branch Chester Creek, TP concentrations were generally lower than on the mainstem (range: 0.07 - and 0.088).
- Dissolved phosphorus concentrations were highest in Goose Creek (Range: 0.017 – 2.295 mg/L) with maximum concentrations downstream of the discharger of Goose Creek WWTP (PA0027031). In Chester Creek, dissolved phosphorus values ranged between 0.263 and 0.830 mg/L, decreasing downstream. Dissolved phosphorus concentrations at stations on West Branch Chester Creek and East Branch Chester Creek were generally significant lower than on the mainstem (range: 0.022 - 0.071).
- TN levels were highest in Goose Creek (Range: 3.05 – 18.76 mg/L) with maximum concentrations found downstream of the discharger of West Goshen Sewer System & STP (PA0028584). In Chester Creek, TN ranged between 5.49 and 13.22 mg/L with concentrations increasing significantly downstream of the discharger of SW Delaware County Municipal Authority DMR (PA0027383). TN concentrations at stations on West Branch Chester Creek and East Branch Chester Creek were lower than on the mainstem (range: 1.35 – 2.16 mg/L). The majority of TN is composed of nitrate.
- Nitrate levels exceeded the PA standard of 10 mg/L for drinking water at GC-4 (12.46 mg/L in May and 16.9 mg/L in August), CC-1 (10.58 mg/L in May), and CC-5 (11.46 mg/L in August). Nitrate levels increased significantly downstream from all three dischargers (PA0027031, PA0028584, and PA0027383). Nitrate concentrations at stations on West Branch Chester Creek and East Branch Chester Creek were significantly lower than on the mainstem (range: 0.86 – 1.95 mg/L).
- Ammonia exceeded the PA standard at GC-2 in May, GC-4 in August, and CC-5 in May. Concentrations in the mainstem ranged between <0.02 and 0.32 mg/L and in the tributaries between <0.02 and 0.60 mg/L.

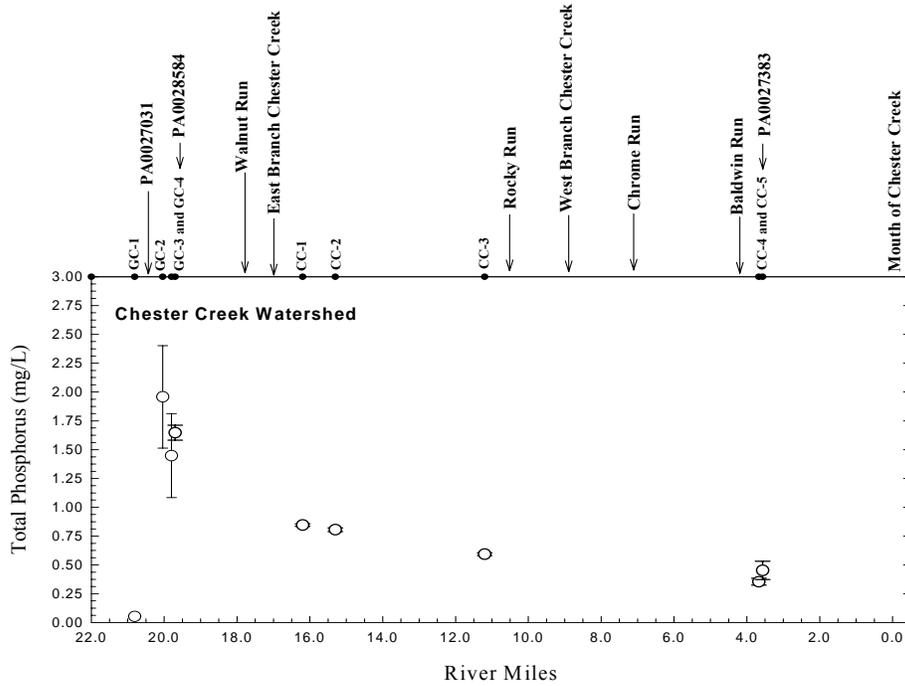


Figure 3-5: Total phosphorus (max, mean, min) in the mainstem of the Chester Creek watershed based on two water quality surveys.

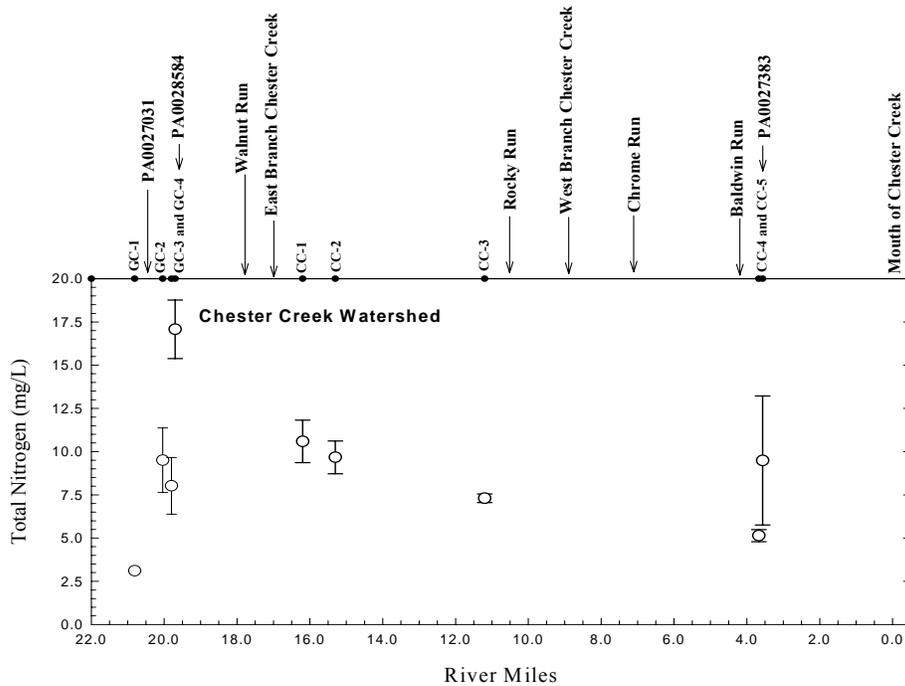


Figure 3-6: Total nitrogen (max, mean, min) in the mainstem of the Chester Creek watershed based on two water quality surveys.

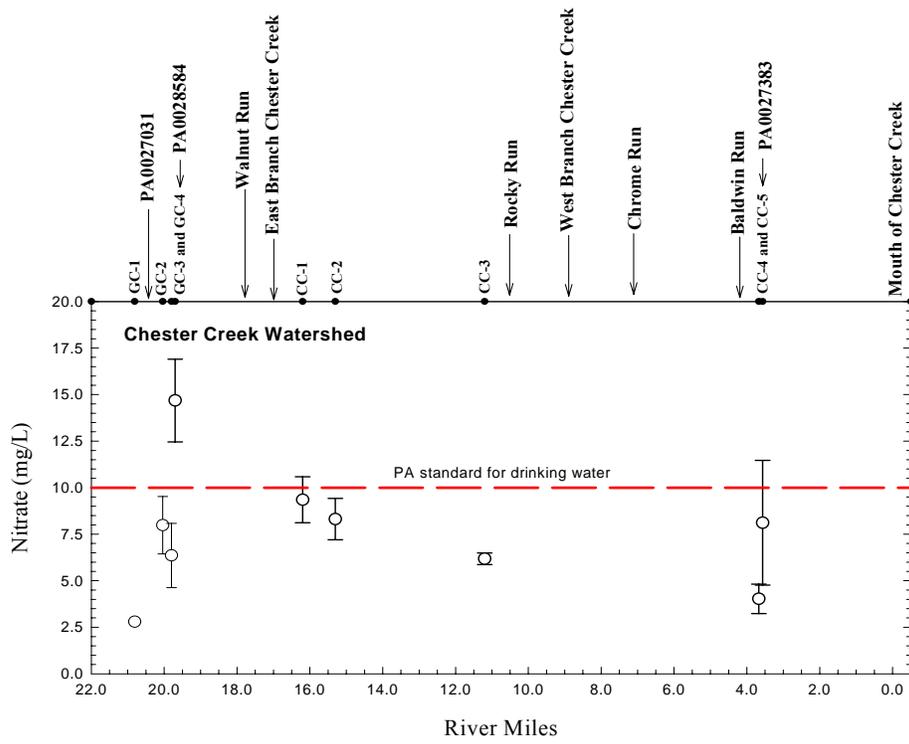


Figure 3-7: Nitrate (max, mean, min) in the mainstem of the Chester Creek watershed based on two water quality surveys.

3.1.3.2. Continuous Measurements

PADEP conducted continuous in-stream measurements for temperature, dissolved oxygen (DO), specific conductivity, and pH at eight stations during two periods – May 22nd to 25th, 2006 and July 31st to August 2nd, 2006 (**Figure 3-3**). In the May survey, six stations were sampled and **Table 3-11** shows the average, minimum, and maximum of the in-stream continuous measurements taken. In the August survey, only three stations were sampled and **Table 3-12** shows the average, minimum, and maximum of the in-stream continuous measurements taken. GC-4 was the only station to be sampled during both surveys. The following summarizes the results of all continuous measurements:

- Measurements of DO at all stations never violated Pennsylvania's minimum standard of 4 mg/L. The lowest DO measured during the continuous DO monitoring was 4.5 mg/L at GC-4 in August.
- Measurements of pH at all stations complied with the state standard.
- Dissolved oxygen swings at GC-4 (on Goose Creek) were 4.9 mg/L in May and 1.8 mg/L in August. In May, dissolved oxygen measurements ranged from 7.4 to 12.3 mg/L. In August, the dissolved oxygen measurements ranged from 4.5 to 6.4 mg/L.
- Specific conductivity at GC-4 averaged 658.5 mg/L and ranged from 596.0 to 681.0 mg/ in May. In the August sampling, the specific conductivity at GC-4 averaged 747.7 mg/L.
- Temperature at GC-4 averaged 15.2 C and ranged from 11.8 to 19.7 C in May. In the August sampling, the temperature at GC-4 averaged 24.3 C and ranged from 23.1 to 25.3 C.

Table 3-11. Summary of Instream Continuous Measurements in May Sampling

GC_4 on Goose Creek					
	Temp	DO	DO	Spec. Cond	pH
	C	mg/L	%	uS/cm	
AVE	15.19	9.67	97.07	658.52	7.51
MIN	11.82	7.38	74.77	596.00	7.28
MAX	19.73	12.29	135.06	681.00	8.04
GC_Mouth at the mouth of Goose Creek					
	Temp	DO	DO	Spec. Cond	pH
	C	mg/L	%	uS/cm	
AVE	16.14	7.64	77.69	782.33	6.89
MIN	14.79	6.72	68.82	767.00	6.79
MAX	17.85	8.83	90.12	802.00	7.04
CC_1 on Chester Creek					
	Temp	DO	DO	Spec. Cond	pH
	C	mg/L	%	uS/cm	
AVE	14.63	10.00	98.91	466.71	7.68
MIN	13.01	9.25	91.21	460.00	7.53
MAX	17.00	10.98	112.67	474.00	7.94
CC_2 on Chester Creek					
	Temp	DO	DO	Spec. Cond	pH
	C	mg/L	%	uS/cm	
AVE	14.94	9.94	98.67	436.61	7.41
MIN	11.86	8.07	78.96	424.00	7.20
MAX	18.42	12.32	130.14	451.00	7.80
CC_5 on Chester Creek					
	Temp	DO	DO	Spec. Cond	pH
	C	mg/L	%	uS/cm	
AVE	15.31	9.24	91.87	390.15	7.84
MIN	13.34	8.48	80.86	363.00	7.60
MAX	17.04	10.40	107.60	423.00	8.42
WBCC_1 on West Branch Chester Creek					
	Temp	DO	DO	Spec. Cond	pH
	C	mg/L	%	uS/cm	
AVE	13.81	10.00	96.48	291.05	7.04
MIN	11.42	9.04	89.85	285.00	6.76
MAX	16.42	10.98	106.59	295.00	7.23

Table 3-12. Summary of Instream Continuous Measurements over two days					
GC_4 on Goose Creek					
	Temp	DO	DO	Spec. Cond	pH
	C	mg/L	%	uS/cm	
AVE	24.31	5.31	50.59	747.73	7.38
MIN	23.12	4.48	44.23	738.00	7.27
MAX	25.26	6.28	58.27	756.00	7.48
GC_1 on Chester Creek					
	Temp	DO	DO	Spec. Cond	pH
	C	mg/L	%	uS/cm	
AVE	24.28	6.19		744.31	7.07
MIN	22.38	5.41		731.00	6.98
MAX	26.02	7.29		756.00	7.18
CC_3 on Chester Creek					
	Temp	DO	DO	Spec. Cond	pH
	C	mg/L	%	uS/cm	
AVE		6.59		431.91	7.84
MIN	24.34	6.05		407.00	7.68
MAX	28.29	7.47		455.00	8.15

3.1.3.3. Discharger Sampling

As requested by EPA and PADEP, 28 dischargers in the watershed collected water quality measurements and flow measurements in May and August of 2006. Water quality parameters requested included: CBOD₅, CBOD₂₀, TSS, TDS, Organic N, NH₃-N, NO₂-N, NO₃-N, TN, Total dissolved P, Ortho P, Dissolved ortho P, TP, Conductivity, alkalinity, pH, and DO.

Table 3-13 through Table 3-16 show the flow, TP and TN concentrations, and TP and TN loads for each point source in May and August. The loads in both tables are organized in descending order. The following results can be summarized:

- The majority of dischargers, which ranked high for total phosphorus loads, also ranked high for total nitrogen loads.
- The highest loads for TP and TN were found at West Goshen (PA0028584), SW Delaware County Municipal Authority DMR (PA0027383), and Goose Creek WWTP (PA0027031).

Table 3-13. TP Loads from 27 Point Sources in the Chester Creek Watershed in May 2006

Name of Discharger	Permit Number	Category	Receiving Water body	Average flow (cfs)	Total P (mg/L)	Total P (Ib/day)
West Goshen Township Sewer Authority	PA0028584	STP	Goose	7.3354	1.925	76.164
GOOSE CREEK WWTP	PA0027031	STP	Goose	1.0877	4.77	27.985
SW Delaware County Municipal Authority DMR	PA0027383	STP	Chester	6.3962	0.63	21.735
Westtown Chester Creek STP	PA0031771	STP	EBCC	0.2564	3.9	5.393
Thornbury Twp Delaware Cnty	PA0053473	STP	Chester	0.1748	5.6	5.281
Brookhaven Boro Delaware Cnty	PA0023949	STP	Chester	0.2076	3.1	3.472
Glen Mills School STP	PA0031747	STP	Chester	0.0995	6.2	3.327
Concord Township Sewer Authority	PA0055212	STP	WBCC	1.1651	0.43	2.702
Springhill Farm Wwtp Assn	PA0052230	STP	WBCC	0.0805	5.8	2.517
Valleybrook Homeowners Assoc Npdes	PA0040576	STP	WBCC	0.0444	5.6	1.341
WESTTOWN SCHOOL	PA0050652	STP	EBCC	0.0251	9	1.217
State Farm Mutual Auto Ins Co	PA0051756	STP	WBCC	0.0220	7.2	0.856
Cheyney University of PA	PA0030970	STP	EBCC	0.0634	2.5	0.855
Walnut Hill Utility Co	PA0050237	STP	Chester	0.0314	4.2	0.711
Pantos Corp/Coventry Crossing	PA0052434	STP	WBCC	0.0193	4.5	0.469
Stone Mill Estates LP/Riviera at Concord	PA 0054780	STP	WBCC	0.0294	2.49	0.395
Amer Comm Mgmt Svc/Concord Ind. Park	PA0032301	STP	WBCC	0.0133	4.4	0.316
Southco Inc	PA0051161	STP	WBCC	0.0065	9	0.315
Garnet Valley Sch Dist	PA0031208	STP	WBCC	0.0067	8.6	0.309
Brinton Manor Inc.	PA0044474	STP	WBCC	0.0042	8.1	0.183
Malvern School at Glen Mills	PA0056821	STP	Chester	0.0114	2.3	0.142
Concord Country Club	PA0031666	STP	WBCC	0.0077	2.7	0.113
COTT BEVERAGE	PA0050431	Industrial	WBCC	0.0746	0.115	0.046
Laurel Pipe Line Company, L.P.	PA0012467	Industrial	WBCC	0.0382	<0.080	0.008
Wawa, Inc.	PA0058769	Industrial	Rocky Run	0.0037	0.28	0.006
Westlake Plastics Company	PA0051438	Industrial	Chester	0.0003	0.056	0.000
Sleighton School WWTF	PA0029980	STP	Rocky Run		0.2/0.3	

Table 3-14. TP Loads from 28 Point Sources in the Chester Creek Watershed in August 2006

Name of Discharger	Permit Number	Category	Receiving Water body	Average flow (cfs)	Total P (mg/L)	Total P (lb/day)
SW Delaware County Municipal Authority DMR	PA0027383	STP	Chester	6.7150	2.470	89.461
West Goshen Township Sewer Authority	PA0028584	STP	Goose	7.1173	1.800	69.100
GOOSE CREEK WWTP	PA0027031	STP	Goose	1.3399	3.930	28.403
Thornbury Twp Delaware Cnty	PA0053473	STP	Chester	0.2042	6.190	6.819
Westtown Chester Creek STP	PA0031771	STP	EBCC	0.3636	3.430	6.727
Cheyney University of PA	PA0030970	STP	EBCC	0.6498	1.300	4.557
Glen Mills School STP	PA0031747	STP	Chester	0.1129	6.150	3.747
Concord Township Sewer Authority	PA0055212	STP	WBCC	1.0707	0.620	3.581
Brookhaven Boro Delaware Cnty	PA0023949	STP	Chester	0.2104	2.960	3.360
Springhill Farm Wwtp Assn	PA0052230	STP	WBCC	0.0805	7.060	3.064
State Farm Mutual Auto Ins Co	PA0051756	STP	WBCC	0.0292	8.210	1.295
WESTTOWN SCHOOL	PA0050652	STP	EBCC	0.0283	7.600	1.161
Walnut Hill Utility Co	PA0050237	STP	Chester	0.0449	4.180	1.012
Southco Inc	PA0051161	STP	WBCC	0.0155	9.290	0.775
Pantos Corp/Coventry Crossing	PA0052434	STP	WBCC	0.0263	4.040	0.573
Stone Mill Estates LP/Riviera at Concord	PA 0054780	STP	WBCC	0.0294	2.820	0.447
Concord Country Club	PA0031666	STP	WBCC	0.0110	6.720	0.398
Brinton Manor Inc.	PA0044474	STP	WBCC	0.0093	6.350	0.318
Amer Comm Mgmt Svc/Concord Ind. Park	PA0032301	STP	WBCC	0.0077	5.840	0.244
Valleybrook Homeowners Assoc Npdes	PA0040576	STP	WBCC	0.0077	5.840	0.244
Malvern School at Glen Mills	PA0056821	STP	Chester	0.0087	3.870	0.181
Garnet Valley Sch Dist	PA0031208	STP	WBCC	0.0031	5.170	0.086
COTT BEVERAGE	PA0050431	Industrial	WBCC	0.0746	0.096	0.039
Laurel Pipe Line Company, L.P.	PA0012467	Industrial	WBCC	0.0393	0.040	0.008
Wawa, Inc.	PA0058769	Industrial	Rocky Run	0.0037	0.220	0.004
Westlake Plastics Company	PA0051438	Industrial	Chester	0.0003	0.237	0.0004
Sleighton School WWTF	PA0029980	STP	Rocky Run		0.300	
Fox Valley Community Services, Inc.	PA0030431	STP	WBCC			

Table 3-15. TN Loads from 27 Point Sources in the Chester Creek Watershed in May 2006

Name of Discharger	Permit Number	Category	Receiving Water body	Average flow (cfs)	Total N (mg/L)	Total N (lb/day)
SW Delaware County Municipal Authority DMR	PA0027383	STP	Chester	6.3962	30.4	1048.797
West Goshen Township Sewer Authority	PA0028584	STP	Goose	7.3354	19.6	775.485
Concord Township Sewer Authority	PA0055212	STP	WBCC	1.1651	44.54	279.893
GOOSE CREEK WWTP	PA0027031	STP	Goose	1.0877	15.3	89.762
Westtown Chester Creek STP	PA0031771	STP	EBCC	0.2564	29	40.102
Thornbury Twp Delaware Cnty	PA0053473	STP	Chester	0.1748	34.42	32.459
Brookhaven Boro Delaware Cnty	PA0023949	STP	Chester	0.2076	24.48	27.416
Glen Mills School STP	PA0031747	STP	Chester	0.0995	34.14	18.320
Valleybrook Homeowners Assoc Npdes	PA0040576	STP	WBCC	0.0444	37.8	9.054
Stone Mill Estates LP/Riviera at Concord	PA 0054780	STP	WBCC	0.0294	40.74	6.460
Walnut Hill Utility Co	PA0050237	STP	Chester	0.0314	29.6	5.010
State Farm Mutual Auto Ins Co	PA0051756	STP	WBCC	0.0220	35.94	4.270
Amer Comm Mgmt Svc/Concord Ind. Park	PA0032301	STP	WBCC	0.0133	57.7	4.141
Springhill Farm Wwtp Assn	PA0052230	STP	WBCC	0.0805	9.54	4.140
Southco Inc	PA0051161	STP	WBCC	0.0065	110.1	3.859
Garnet Valley Sch Dist	PA0031208	STP	WBCC	0.0067	88.96	3.200
Pantos Corp/Coventry Crossing	PA0052434	STP	WBCC	0.0193	17.4	1.815
COTT BEVERAGE	PA0050431	Industrial	WBCC	0.0746	4.03	1.621
Malvern School at Glen Mills	PA0056821	STP	Chester	0.0114	11.9	0.734
Concord Country Club	PA0031666	STP	WBCC	0.0077	19.2	0.801
Cheyney University of PA	PA0030970	STP	EBCC	0.0634	2.1	0.719
WESTTOWN SCHOOL	PA0050652	STP	EBCC	0.0251	4.4	0.595
Laurel Pipe Line Company, L.P.	PA0012467	Industrial	WBCC	0.0382	0.852	0.176
Brinton Manor Inc.	PA0044474	STP	WBCC	0.0042	5.54	0.125
Wawa, Inc.	PA0058769	Industrial	Rocky Run	0.0037	1.2	0.024
Westlake Plastics Company	PA0051438	Industrial	Chester	0.0003	3.98	0.007
Sleighton School WWTF	PA0029980	STP	Rocky Run			

Table 3-16. TN Loads from 28 Point Sources in the Chester Creek Watershed in August 2006

Name of Discharger	Permit Number	Category	Receiving Water body	Average flow (cfs)	Total N (mg/L)	Total N (lb/day)
West Goshen Township Sewer Authority	PA0028584	STP	Goose	7.1173	24.10	925.172
SW Delaware County Municipal Authority DMR	PA0027383	STP	Chester	6.7150	15.90	575.883
Concord Township Sewer Authority	PA0055212	STP	WBCC	1.0707	39.57	228.518
Westtown Chester Creek STP	PA0031771	STP	EBCC	0.3636	23.00	45.107
Thornbury Twp Delaware Cnty	PA0053473	STP	Chester	0.2042	40.20	44.284
Brookhaven Boro Delaware Cnty	PA0023949	STP	Chester	0.2104	23.00	26.104
GOOSE CREEK WWTP	PA0027031	STP	Goose	1.3399	3.23	23.344
State Farm Mutual Auto Ins Co	PA0051756	STP	WBCC	0.0292	58.60	9.243
Walnut Hill Utility Co	PA0050237	STP	Chester	0.0449	28.90	6.994
Stone Mill Estates LP/Riviera at Concord	PA 0054780	STP	WBCC	0.0294	40.86	6.479
Glen Mills School STP	PA0031747	STP	Chester	0.1129	10.54	6.421
Southco Inc	PA0051161	STP	WBCC	0.0155	56.70	4.732
Springhill Farm Wwtp Assn	PA0052230	STP	WBCC	0.0805	7.68	3.333
Valleybrook Homeowners Assoc Npdes	PA0040576	STP	WBCC	0.0077	65.60	2.737
Amer Comm Mgmt Svc/Concord Ind. Park	PA0032301	STP	WBCC	0.0077	65.60	2.737
Pantos Corp/Coventry Crossing	PA0052434	STP	WBCC	0.0263	14.84	2.105
Malvern School at Glen Mills	PA0056821	STP	Chester	0.0087	31.26	1.461
Garnet Valley Sch Dist	PA0031208	STP	WBCC	0.0031	43.60	0.728
COTT BEVERAGE	PA0050431	Industrial	WBCC	0.0746	1.56	0.628
Concord Country Club	PA0031666	STP	WBCC	0.0110	7.46	0.442
Cheyney University of PA	PA0030970	STP	EBCC	0.6498	0.10	0.351
WESTTOWN SCHOOL	PA0050652	STP	EBCC	0.0283	2.00	0.305
Laurel Pipe Line Company, L.P.	PA0012467	Industrial	WBCC	0.0393	0.54	0.114
Brinton Manor Inc.	PA0044474	STP	WBCC	0.0093	2.42	0.121
Wawa, Inc.	PA0058769	Industrial	Rocky Run	0.0037	3.30	0.066
Westlake Plastics Company	PA0051438	Industrial	Chester	0.0003	5.47	0.009
Sleighton School WWTF	PA0029980	STP	Rocky Run		1.62	
Fox Valley Community Services, Inc.	PA0030431	STP	WBCC			

3.1.3.4. Volatile Organic Compound Sampling

On October 16, 2006, a sample was collected on Goose Creek, approximately 50 feet upstream of the Goose Creek STP (PA0027031), and analyzed for a number of volatile organic compounds. The sample was used to assess the validity of the priority organics

listing given to Chester Creek in 1998. The original listing had been based on sampling conducted by PADEP after an unknown quantity of cooling water and Sartomer Company monomer (composed of toluene and xylene) breached an impoundment and flowed into Goose Creek. The event was acute short-term surface spill and no lasting impact had been observed since the event.

Based on the results of the sampling, there were no measurable concentrations of toluene and xylene – the two compounds of interest when the original 303(d) listing was made. Trichloroethylene and 1,1,2,2-Tetrachloroethane were found in concentrations below the continuous and maximum aquatic life criteria. However, the measured concentration of 1,1,2,2-Tetrachloroethane exceeded the human health criteria of 0.17 ug/L. This exceedance could be caused by groundwater contamination from degreasers by industrial activity in the area.

3.2 Supplemental Water Quality Monitoring Data

3.2.1 United States Geological Survey (USGS)

The United States Geological Survey (USGS) has conducted biological and chemical sampling at six sites in the watershed in Chester County (**Figure 3-1, Table 3-17**). One of these sites was on Goose Creek and another on Chester Creek, while the remaining four lie on tributaries of Chester Creek (three on East Branch Chester Creek and one on West Branch Chester Creek). Sampling at these sites was performed approximately once a year from 1970 to 1997.

Table 3-17. Summary of USGS Monitoring Program

USGS Station Number	Data Type	Period	Frequency
USGS - 01476790	Biological/Chemical	1970-1997	Yearly
USGS - 01476830	Biological/Chemical	1970-1996	Yearly
USGS - 01476835	Biological/Chemical	1970-2004	Yearly
USGS - 01476950	Chemical	2000	
USGS - 01476840	Biological/Chemical	1981-1982, 1988-1997	Yearly
USGS - 01476848	Biological/Chemical	1983-1996	Yearly

Biological Monitoring Data

Biological monitoring data obtained between 1970 and 1997 was summarized in comprehensive reports prepared by the USGS (Reif, 2004; Reif, 1999; Reif, 2002; and Moore, 1989). Monitoring data from these reports covers the Chester County portions of both the East Branch Chester Creek and Goose Creek tributaries.

Based on these reports, the upper portions of East Branch Chester Creek (Stations 01476790 and 01476830) showed a reduced taxa richness, but a relatively high % Ephemeroptera, Plecoptera, Trichoptera macroinvertebrates (EPT), indicating only a slightly impacted condition prior to 1987. However, after 1987, an increase in Hilsenhoff Biotic Index (HBI) scores and an increase in pollutant tolerant species, as well as noted algal growth on the stream bottom, suggested organic enrichment was occurring at these sites. A high proportion of pollutant tolerant species was also noted just downstream from these sites at station 01476835. Phosphorus concentrations and ammonia levels at this station are elevated and variable due to wastewater treatment plant inputs immediately upstream (Reif, 2002).

Sampling station 01476840 on Goose Creek and station 01476848 on Chester Creek, below the confluence of Goose Creek and East Branch Chester Creek, were monitored between 1981 and 1987. Monitoring data from both of these stations suggest a slightly to moderately impacted benthic community as a result of organic pollution. Both sites are downstream from a wastewater treatment plant. Following plant improvements in

1982, benthic macroinvertebrate community metrics improved, but are still below reference conditions for the region (Reif, 2002; Reif, 2004).

Overall, benthic monitoring data from 1970 – 1997 show a general upward trend in taxa richness at all sites within the Chester County portions of the Chester Creek watershed. However, the increase in taxa richness also coincides with an apparent decrease in the %EPT metric suggesting a conversion of the benthic community to more pollutant tolerant species. HBI scores over this period are variable between stations. With the exception of station 01476790 in the headwaters of East Branch Chester Creek, scores at the stations were indicative of slightly impacted conditions (>4.5) (**Figure 3-8**).

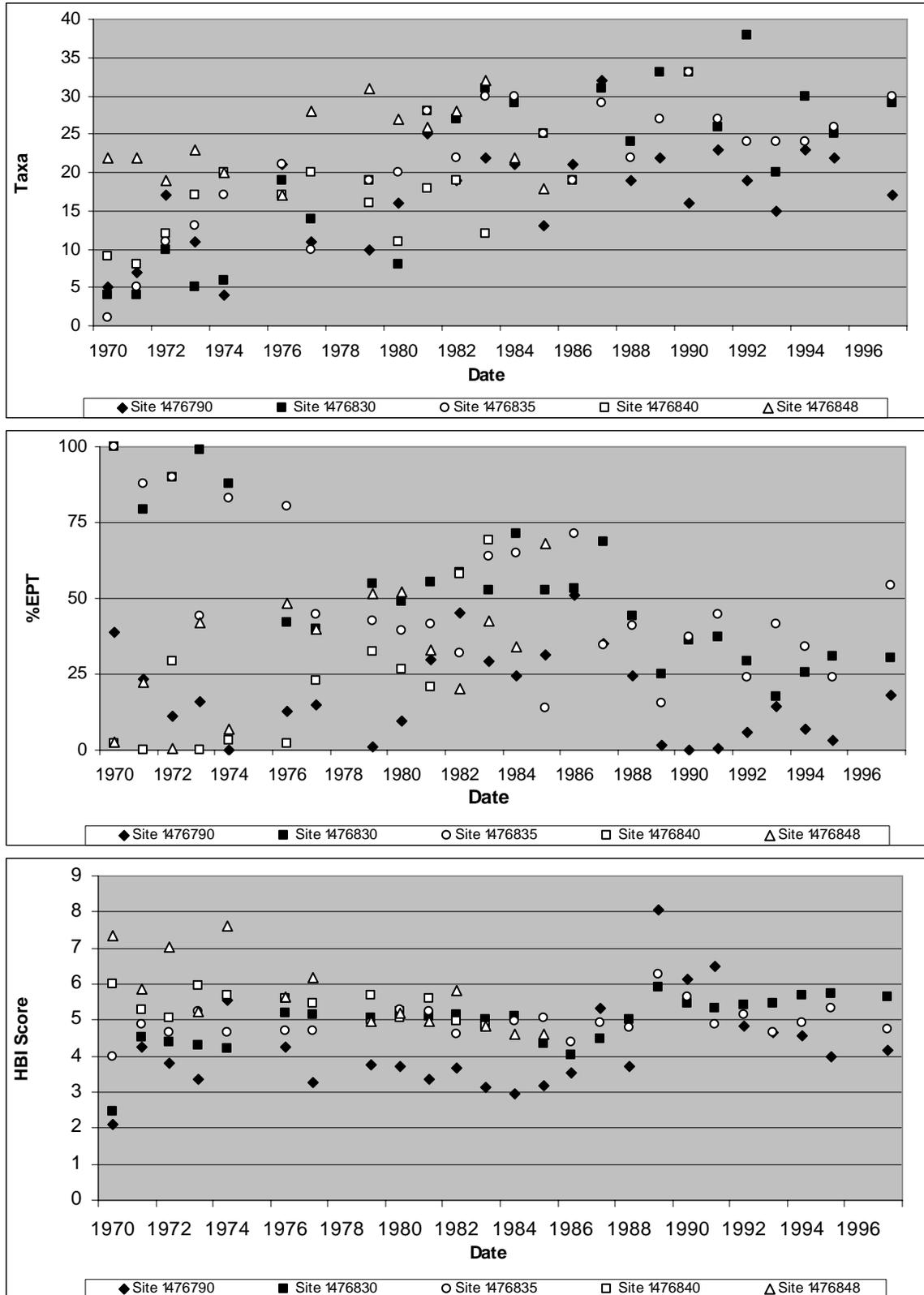


Figure 3-8: Benthic Macroinvertebrate Metrics from 1970 – 1997 for Sampling Stations in Chester County (Reif, 2005).

Water Quality Data

Six USGS water quality stations are located in the Chester Creek watershed. One of these sites is on Goose Creek (USGS 01476840) and another on Chester Creek (USGS 01476848), while the remaining four lie on tributaries of Chester Creek (three on East Branch Chester Creek (USGS 01476790, 01476830, and 01476835) and one on West Branch Chester Creek (USGS 01476950)).

Data were analyzed for selected in-stream parameters such as general water quality parameters (temperature, DO, pH, specific conductivity, acid neutralization capacity, hardness, alkalinity, bicarbonates, sulfates, total Kjeldahl nitrogen, ammonia, nitrate, nitrite, ortho-phosphorus, total phosphorus, suspended solids, and turbidity), metals (cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc) and all available organics. All parameters were evaluated to determine whether they complied with Pennsylvania's established water quality standards.

Apart from instream water quality parameters, USGS also sampled riverbed sediments for metals and organics. The measurements were not analyzed, because no water quality standards exist for toxic sediments.

All general water quality parameters were in compliance with water quality standards (PADEP, 2005) except for three: total recoverable manganese, which exceeded the standard on one occasion at station 01476790 (East Branch Chester Creek); NO_x-N, which exceeded the standard on seven occasions at station 01476840 (Chester Creek); and ammonia on six occasions at three stations (01476840 on Goose Creek, 01476848 and 01476950 on Chester Creek).

Nutrient concentrations (nitrate, ortho-phosphorus, and TP) ranged considerably depending on the stations (**Table 3-18**). In the West Branch Chester Creek, nitrate levels were found to be abundant along the entire stream (range from averages: 2.14 - 4.17 mg/L); phosphorus levels were significantly higher in the most downstream station (mean: 0.205 mg/L, min.: 0.083 mg/L, max.: 0.372 mg/L) than in the headwater stations (range from averages: 0.018 - 0.020 mg/L). At stations on Goose Creek and the

mainstem of Chester Creek, the averages of both nitrate and phosphorus levels ranged between 8.74 – 14.18 mg/L and 1.43 – 3.07 mg/L, respectively.

All available total metal data collected (arsenic, barium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, silver, vanadium, and zinc) were analyzed to determine whether the examined parameters complied with Pennsylvania's established water quality standards for CCC and CMC. Ambient metals were only measured for the stations located on Goose Creek and Chester Creek (USGS stations at the tributaries had no metal measurements, only measurements for metals in riverbed sediments). The metal surveys were conducted on three occasions between 1990 and 1992. For sampling periods where hardness concentration was not available, hardness was estimated based on an average of available measurements (see footnotes on **Table 3-19**). For fish and aquatic life criteria, most of the exceedances found were for copper at stations on Goose Creek and Chester Creek. Additional exceedances for lead and silver were found only on Chester Creek (**Tables 3-19 and 3-20**). No exceedances were observed for the human health criteria.

All available organic data collected by USGS in the Chester Creek watershed were analyzed to determine whether the examined parameters complied with Pennsylvania's established water quality standards for CCC and CMC. No exceedances of the fish and aquatic life and human health criteria were observed. The majority of dissolved organic parameters measured fell below detection limits.

Table 3-18. Water Quality at the USGS Monitoring Stations in the Chester Creek Watershed

Station	Temp	DO	pH	Cond.	ANC	Hardn.	Alk.	Bicarb.	SO ₄	TKN	NH ₃	NO ₃ -	PO ₄ -	TP	SS	Turb.
	C	mg/L		uSim/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU
1476790 East Branch Chester Creek	Count	8	8	8	7	2			3	3	7	7	7	3		3
	Ave	9.7	6.9	367.3	60.1	34.0			15.7	0.17	0.04	4.17	0.014	0.018		2.9
	Min	9.0	6.8	310.0	50.0	23.0			14.0	0.10	0.01	3.80	0.005	0.005		0.4
	Max	10.6	7.2	475.0	81.0	45.0			17.0	0.30	0.10	4.32	0.020	0.030		7.6
	Range	1990-1997	1990-1997	1990-1997	1990-1997	1990-1991			1990-1992	1990-1992	1990-1997	1990-1997	1990-1997	1990-1992		1990-1992
1476830 East Branch Chester Creek	Count	7	7	7	7	2			3	3	7	7	7	3		3
	Ave	12.3	10.6	7.2	316.0	71.9	29.5		25.3	0.30	0.04	2.14	0.019	0.020		1.5
	Min	8.5	9.0	6.5	298.0	57.0	29.0		21.0	0.20	0.01	1.70	0.010	0.020		0.7
	Max	15.0	11.8	7.6	332.0	92.0	30.0		34.0	0.40	0.13	3.10	0.030	0.020		2.9
	Range	1990-1996	1990-1996	1990-1996	1990-1996	1990-1996	1990-1991		1990-1992	1990-1992	1990-1996	1990-1996	1990-1996	1990-1992		1990-1992
1476835 East Branch Chester Creek	Count	7	7	7	7		7				7	7		7		
	Ave	10.9	10.4	7.3	354.7		66.6				0.02	3.02		0.205		
	Min	6.2	8.2	6.8	288.0		48.0				0.02	2.56		0.083		
	Max	14.0	12.9	7.6	426.0		86.0				0.03	4.11		0.372		
	Range	1998-2004	1998-2004	1998-2004	1998-2004		1998-2004				1998-2004	1998-2004		1998-2004		
01476950 West Branch Chester Creek	Count	3	3	3	3		2	2	2	2	2	2	2	2	2	2
	Ave	19.0	9.2	7.7	304.3		47.5	57.5	21.1	0.23	0.02	3.46	0.11	0.14	6.00	2.9
	Min	16.1	8.3	7.5	280.0		44.0	53.0	18.5	0.22	0.02	2.40	0.06	0.09	5.00	2.7
	Max	21.9	10.5	8.0	329.0		51.0	62.0	23.7	0.24	0.02	4.52	0.15	0.19	7.00	3.0
	Range	2000	2000	2000	2000		2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
01476840 Goose Creek	Count	8	8	8	8	1				3	8	8	8	3		3
	Ave	14.0	9.8	7.3	673.6	73.4	49.0			1.33	0.15	14.18	2.29	3.07		2.7
	Min	11.0	8.5	7.0	484.0	45.0	49.0			0.80	0.02	5.50	1.10	2.60		2.2
	Max	15.5	10.8	7.8	850.0	114.0	49.0			2.10	0.33	18.00	3.20	3.50		3.5
	Range	1990-1997	1990-1997	1990-1997	1990-1997	1990-1997	1991			1990-1992	1990-1997	1990-1997	1990-1997	1990-1997	1990-1992	1990-1992
01476848 Chester Creek	Count	7	7	7	7	2			3	3	7	7	7	3		3
	Ave	11.9	9.8	7.2	513.7	70.9	55.5		52.3	0.90	0.12	8.74	1.25	1.43		1.3
	Min	9.0	8.6	6.5	448.0	62.0	55.0		36.0	0.50	0.01	6.80	1.00	1.30		0.6
	Max	16.0	11.3	7.6	590.0	76.0	56.0		85.0	1.60	0.47	9.80	1.54	1.50		2.0
	Range	1990-1996	1990-1996	1990-1996	1990-1996	1990-1996	1990-1991		1990-1992	1990-1992	1990-1996	1990-1996	1990-1996	1990-1992		1990-1992

Cond.: Specific Conductivity; ANC: Acid Neutralizing Capacity; Hardn.: Hardness based on CaCO₃; Bicarb.: Bicarbonates; NO_x-N: NO₃-N + NO₂-N; SS: Suspended Solids; NTU: nephelometric turbidity units

Table 3-19. Number of Exceedances for Total Recoverable Metals at USGS Stations

	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Zinc
CCC ¹	0/6	0/6	5/6	2/6	0/6	0/6	0/6	-*	0/6
CMC ¹	0/6	0/6	5/6	0/6	0/6	0/6	-*	1/6	0/6

¹ Number of exceedances to number of observed metals
 * No standard is defined

Table 3-20. Exceedances of Total Recoverable Metals at USGS Stations

Station	Tot. Cd		Tot. Cr		Tot. Cu		Tot. Pb		Tot. Hg		Tot. Ni		Tot. Se		Tot. Ag		Tot. Zn	
	CCC	CMC																
01476840 Goose Creek*					√	√												
01476848 Chester Creek**					√	√	√									√		

* hardness were estimated (here:49 mg/L) based on the only available measurement from 1991
 ** hardness were estimated (here:55.5 mg/L) based on an average of two measurements taken in 1990 and 1991

3.2.2 National Park Service (NPS)

The National Park Service conducted biological and chemical sampling as well as hydrological measurements at three sites in the Chester Creek watershed. Samples were conducted once in the morning and once in the afternoon on September 9, 1997.

Biological Monitoring Data

The three biological samples collected were analyzed using two methods, the Beck Biotic index and the Shannon-Weaver Diversity Index (**Table 3-21**). The Beck Biotic Index is a weighted sum of intolerant taxa, and the Shannon-Weaver Diversity Index generally characterizes biotic integrity. Both of these indices are expected to decrease in response to disturbance. Station VAFO_CHS_CREEK, the only station located on the impaired section of Chester Creek, received lower biotic scores in comparison to the two stations located on tributaries.

Sample	Beck Biotic Index	Diversity Index, Shannon-Weaver
VAFO_CHS_WEST	13	1.79
VAFO_CHS_CREEK	9	0.85
VAFO_CHS_NEWLIN	13	1.64

Water Quality Data

Six water quality samples were collected by the National Park Service in the Chester Creek watershed. Based on this survey, temperature, dissolved oxygen, alkalinity, and pH (except for one sample: VAFO_CHS_WEST) were in compliance with water quality standards (PADEP, 2005). Nutrient concentrations (nitrate and ortho-phosphorus) were generally abundant and highest for the samples from Chester Creek (VAFO_CHS_CREEK VAFO_CCHD_CREEK) with concentrations of 8.4 mg/L for

nitrate and 1.38 mg/L for ortho-phosphorus (Table 3-22). Fecal coliform and fecal streptococci ranged from 40 to 480 col/100ml (Table 3-23).

Table 3-22. Water Quality Parameters at the National Park Service Monitoring Stations									
Sample	Temp.	DO	DO	Field pH	Spec. Cond.	Tot. Alk.	BOD ₅	NO ₃ -N	PO ₄ -P
	° C	mg/L	%		µMHO/cm	mg/L	mg/L	mg/L	mg/L
VAFO_CCHD_CREEK	-	12.40	-	7.15	551	57	0.60	8.40	1.380
VAFO_CCHD_NEWL	-	12.80	-	7.60	329	57	0.40	2.20	0.110
VAFO_CCHD_WEST	-	12.80	-	6.98	328	65	0.80	1.00	0.010
VAFO_CHS_CREEK	10.70	11.00	99.10	7.50	561	60	-		0.700
VAFO_CHS_NEWLIN	13.00	11.00	103.77	7.60	335	57	-	3.10	0.130
VAFO_CHS_WEST	15.10	9.00	88.24	4.30	390	77	-	0.80	0.040

Spec. Cond.: Specific Conductivity; Tot. Alk.: Total Alkalinity as CaCO₃

Table 3-23. Water Quality Parameters at the National Park Service Monitoring Stations					
Sample	F. Tot. Res.	Turb. ¹	Fec. Col.	Fec. Strept.	Ratio of Fecal Coliform to Fecal Streptococci
	mg/L		Count/100ml	Count/100ml	
VAFO_CCHD_CREEK	331	-	-	-	-
VAFO_CCHD_NEWL	202	-	-	-	-
VAFO_CCHD_WEST	230	-	-	-	-
VAFO_CHS_CREEK	284	1.50	470	270	1.74
VAFO_CHS_NEWLIN	185	0.76	40	480	0.08
VAFO_CHS_WEST	200	1.10	465	385	1.21

F. Tot. Res.: Filterable Total Residue; Fec. Col.: Fecal Coliform; Fec. Strept.: Fecal Streptococci
¹ Turbidity in Formazin Turbidity Unit

3.2.3 Community Water Quality Monitoring Programs

The Chester Ridley Crum Volunteer Monitoring Program has four ambient water quality sampling sites in the Chester Creek watershed all located at road crossings. Much of the sampling was done in 2000, 2004, and 2005. The Chester Creek Watershed Association has conducted a number of watershed surveys and nutrient profiles in the watershed, sampling 18 different areas for ambient water quality in 2004 and 2005. Samples from the Chester Ridley Crum and Chester Creek Watershed Association are presented in **Table 3-24**, and sample locations plotted in **Figure 3-1**.

Table 3-24. Private Groups in the Chester Creek Watershed				
Agency	Location	Data Type/ Frequency (if applicable)	Collection Period(s)	Number of Samples
Chester Ridley Crum Volunteer Monitoring Program	Westbourne Rd and Goose Creek	Ambient/ Monthly	May 2004-June 2004, August 2004, October 2004-July 2005	14
Chester Ridley Crum Volunteer Monitoring Program	Goose Creek and Oakbourne Rd	Ambient/ Monthly	May 2004, October 2004-July 2005	11
Chester Ridley Crum Volunteer Monitoring Program	Chester Creek and Sweetwater Rd, Glen Mills	Ambient/ Monthly	October 2000-June 2005	50
Chester Ridley Crum Volunteer Monitoring Program	Chester Creek	Ambient/ Monthly	January 2004-September 2005	21
Chester Ridley Crum Volunteer Monitoring Program	Chester Creek and Locksley Road	Ambient ¹	April 2004, August 2005	3
Chester Ridley Crum Volunteer Monitoring Program	East Branch of Chester Creek and Westtown Rd	Ambient	April 2004	1
Chester Ridley Crum Volunteer Monitoring Program	Goose Creek and Trellis Rd	Ambient	April 2004	1
Chester Ridley Crum Volunteer Monitoring Program	Goose Creek and PA Route 926	Ambient ²	April 2004, March 2005, August 2005	4
Chester Ridley Crum Volunteer Monitoring Program	Chester Creek and Sweetwater Road(Glen Mills)	Ambient	April 2004, March 2005, August 2005	3

Table 3-24. Private Groups in the Chester Creek Watershed

Table 3-24. Private Groups in the Chester Creek Watershed				
Chester Ridley Crum Volunteer Monitoring Program	Chester Creek at Lenni	Ambient	April 2004, March 2005	2
Chester Ridley Crum Volunteer Monitoring Program	Mouth of West Branch Chester Creek and Convent Rd	Ambient	April 2004	1
Chester Ridley Crum Volunteer Monitoring Program	Chester Cr and Dutton Mill Rd	Ambient	March, April, August 2005	3
Chester Ridley Crum Volunteer Monitoring Program	White Clay at Strickersville	Ambient	March 2005	1
Chester Ridley Crum Volunteer Monitoring Program	West Branch Brandy at Modena	Ambient	March 2005	1
Chester Ridley Crum Volunteer Monitoring Program	EBDT	Ambient	March 2005	1
Chester Ridley Crum Volunteer Monitoring Program	Goose Creek and at Alumni Road (Cheyney stadium)	Ambient	March 2005	1
Chester Ridley Crum Volunteer Monitoring Program	Ridley Creek at Gradyville	Ambient	March 2005	1
Chester Ridley Crum Volunteer Monitoring Program	Ridley Creek and Waterville Road	Ambient	March 2005	1
¹ . Continuous data for temperature, pH, specific conductance, and dissolved oxygen are available from April 26, 2004 at Locksley Road Bridge. ² . Continuous data for temperature, pH, specific conductance, and dissolved oxygen are available from August 3-4, 2005 at the intersection of Route 926 and Goose Creek. In addition to this data, there is also a monthly sample for nitrate and total reactive phosphorous.				

Based on monitoring data from the Chester Ridley Crum Volunteer Monitoring Program, dissolved oxygen, pH, and alkalinity were in compliance with water quality standards (PADEP, 2005). Dissolved phosphorus and nitrate, however, were abundant with an overall average of 8.0 mg/L for nitrate (overall range: 2 mg/L – 30 mg/L) and 0.42 mg/L for dissolved phosphorus (overall range: 0.0 – 8.8 mg/L). Specific conductivity ranged overall from 330 to 690 µS/cm (overall average was 546 µS/cm). Similar results for water quality parameters were measured by the local watershed association. Alkalinity, however, was observed well below the PA water quality standard of 20 mg/L in 32 percent of the samples taken at Sweetwater Road (Glen Mills). Dissolved phosphorus and

nitrate ranged from 0.10 to 1.56 mg/L for dissolved phosphorus and 1.0 to 9.0 mg/L for nitrate. It should be noted that the nutrients for both voluntary water quality groups were measured using a Hach Water Quality Test Kit.

3.2.4 Discharge Monitoring Reports

Discharge Monitoring Reports (DMR) for each of the individual permitted facilities discharging into the Chester Creek watershed were obtained and analyzed. DMR data and permit exceedances are presented in Appendix B.

4.0 Load Estimates

In order to develop the pollutant load reductions required to achieve water quality goals it is necessary to estimate the pollutant loads under the existing conditions and establish the numeric water quality goals. The nutrient and sediment loads under the existing conditions are presented in the section and provided in detail in the *Nutrient Total Maximum Daily Load in Goose Creek Watershed, Pennsylvania* and *Sediment Total Maximum Daily Load for the Chester Creek Watershed, Pennsylvania*. The above reference documents also include a detailed description of the methods applied in developing the TMDL allocations.

4.1 Existing Nutrient Loads

The existing nutrient loads for the Goose Creek watershed were calculated based on an average of the growing season (April through October) total phosphorus loads. Model input parameters of the existing loads reflect conditions during the year of 2006.

There are currently three major point sources discharging total phosphorus to Goose Creek. **Table 4-1** shows the total phosphorus loads from the three dischargers. **Table 4-2** shows the total phosphorus loads from the nonpoint sources. The nonpoint source loads for the Goose Creek watershed were based on the BasinSim segment 1 model run.

Table 4-1: Existing Total Phosphorus Loads for Point Sources (2006)				
Facility Name	NPDES Permit Number	At each Point Source		
		Flow	Existing TP	
			MGD	mg/L
Schramm Inc	PA0051071	0.08	0.08	0.06
Goose Creek WWTP	PA0027031	0.83	4.35	29.94
West Goshen Township Sewer Authority	PA0028584	4.99	2.03	84.31
Existing Total Phosphorus Load				114.31
¹ Schramm Inc: Based on the facility's recorded average DMR flow (2000 - 2004) and assumed TP concentration (estimated value is based on measured concentrations from other industrial waste located in the Chester Creek watershed) Goose Creek WWTP and West Goshen Township Sewer Authority: Based on the facility's recorded average DMR and Discharger Sampling Surveys for flow and TP concentration				
² Based on the average concentration over the growing season (April-October) using WASP7.2 simulation (existing conditions)				

Table 4-2: Existing Total Phosphorus Load from Nonpoint Sources

BasinSim Outlet	Watershed	Existing TP
		lb/day
Segment 1	Goose Creek	6.30

Table 4-3 indicates that the simulated total phosphorus nonpoint source loads, estimated using the BasinSim nonpoint source model (see *Nutrient Total Maximum Daily Load in Goose Creek Watershed, Pennsylvania*), account for 5% of the total phosphorus load to Goose Creek during the growing season of 2006. This analysis of the point source and nonpoint source total phosphorus contributions shows that Goose Creek is an effluent-dominated stream.

Table 4-3: Total Phosphorus NPS Contributions

Nutrient	Point Source Loads ¹ (lb/day)	Nonpoint Source Loads (lb/day)	Total Load (lb/day)	Nonpoint Source Load Percent of Total
Total Phosphorus	114.31	6.30	120.61	5.0

4.2 Existing Sediment Loads

The point source sediment loads were determined based on each facility's permitted TSS discharge limit and its reported design flow (**Table 4-4**).

Table 4-4: Wasteload Allocation for Permitted Facilities in Chester Creek

Facility Name	NPDES Permit Number	Receiving Waters	Permitted Load (ton/year)
Westtown School STP	PA0050652	EB of Chester Creek 3-G	1.4
Westtown Township STP	PA0031771	EB of Chester Creek	22.6
Cheyney University STP	PA0030970	EB of Chester Creek	12.3
Malvern School at Glen Mills	PA0056821	EB of Chester Creek	0.1
Wawa Food Market #133	PA0058769	UNT to Rocky Run	0.1
Concordville Hotel STP	PA0052744	UNT of WB Chester Creek	1.1
Concord Country Club	PA0031666	UNT to WB Chester Creek	0.5
Southco STP	PA0051161	UNT to WB Chester Creek	0.2
State Farm	PA0051756	UNT to WB Chester Creek	1.1
Springhill Farm Wastewater	PA0052230	UNT to WB Chester Creek	4.6
Sleighton School STP	PA0029980	Rocky Run	2.1
Concord Township Central STP	PA0055212	WB Chester Creek	82.1
Garnet Valley HS STP	PA0031208	Green Creek	0.3

Table 4-4: Wasteload Allocation for Permitted Facilities in Chester Creek

Facility Name	NPDES Permit Number	Receiving Waters	Permitted Load (ton/year)
Riviera at Concord STP	PA0054780	Green Creek	2.9
Coventry Crossing Apt STP	PA0052434	UNT to WB Chester Creek	0.6
Brinton Manor STP	PA0044474	WB Chester Creek	0.6
Concord Beverage IWWTP	PA0050431	UNT to WB Chester Creek	3.3
Fox Valley WWTP	PA0030431	WB Chester Creek	3.4
Concord Industrial Park STP	PA0032301	WB Chester Creek	0.9
Valleybrook Homeowners Assoc STP	PA0040576	WB Chester Creek	3.3
Brookhaven Boro WWTP	PA0023949	Chester Creek	8.8
SW Delaware County Mun Auth WWTP	PA0027383	Chester Creek	273.8
West Goshen STP	PA0028584	Chester Creek (Goose Creek)	273.8
Thornbury Township STP	PA0053473	Chester Creek	8.2
Westlake Plastics IWTP	PA0051438	Chester Creek	0.0
Glen Mills School WWTP	PA0031747	Chester Creek	6.9
Walnut Hill Utility Company STP	PA0050237	Chester Creek	6.8
Goose Creek STP	PA0027031	Chester Creek (Goose Creek)	76.3
Laurel Pipe Line (Boothwyn Station)	PA0012467	Green Creek	No Limit
Sunoco (Twin Oaks Terminal IWSW)	PA0035297	UNT to Baldwin Run	No Limit
Kimberly Clark PA LLC	PA0013081	Chester Creek	No Limit
Resident	PA0055816	UNT to Green Creek	0.008
Resident	PA0058432	UNT to WB Chester Creek	0.015
Resident	PA0055778	UNT to WB Chester Creek	0.008
Resident	PA0057134	UNT to WB Chester Creek	0.015
Resident	PA0056197	UNT to WB Chester Creek-3G	0.008
Resident	PA0055514	UNT to WB Chester Creek	0.009
Resident	PA0054593	UNT to WB Chester Creek	0.006
Resident	PA0058696	Chester Creek	0.015
Resident	PA0056928	UNT to Chester Creek	0.015
Resident	PA0058351	UNT to WB Chester Creek	0.015
Resident	PA0055760	UNT to WB Chester Creek	0.008
Resident	PA0053830	Goose Creek	0.023
Resident	PA0054615	UNT to Green Creek	0.006
Resident	PA0058149	UNT of Chester Creek	0.015
Resident	PA0053881	UNT to WB Chester Creek	0.006
Resident	PA0055786	UNT to WB Chester Creek	0.006
Total			798.2

There are 21 MS4 areas in the Chester Creek watershed. Sediment load from these MS4 areas originate from both nonpoint sources and instream erosion processes. Because MS4 areas are permitted, the sediment load associated with each of these areas was computed. The existing sediment loads for MS4 areas by municipality are presented in **Table 4-5**. **Table 4-6** presents the MS4 sediment loads by land source.

The existing nonpoint source sediment loads for each nonpoint source, excluding the MS4 areas, in the Chester Creek watershed are presented in **Table 4-7**.

Table 4-5: Chester Creek MS4 Wasteload Allocation by Municipality	
Municipality	Existing Load (tons/yr)
Aston Township	856.9
Bethel Township	324.8
Birmingham Township	3.8
Brookhaven Borough	168.1
Chadds Ford Township	44.8
Chester Township	182.6
Chester City	182.6
Chester Heights Borough	434.0
Concord Township	2,378.7
East Goshen Township	623.1
Edgmont Township	193.9
Middletown Township	1774.5
Parkside Borough	12.9
Thornbury Township (Chester County)	274.6
Thornbury Township (Delaware County)	980.2
Upland Borough	114.1
Upper Chichester Township	62.2
West Chester Borough	80.1
West Goshen Township	1350.1
West Whiteland Township	81.6
Westtown Township	985.9
TOTAL	11,109.8

Table 4-6: Chester Creek MS4 Areas Existing Sediment Load by Land Source	
Land Source	Existing Load (ton/year)
Hay/Pasture	160.90
Cropland	1,470.19
Forest	14.70
Barren Lands	627.14
Low Intensity Residential	139.20
High Intensity Residential	8.90
Instream Erosion	8,688.61
Total	11,109.80

Table 4-7: Existing Sediment Loads for Chester Creek (not including MS4 areas)

Source	Land Use Type	Chester Creek Existing Sediment Load (tons/yr)
Land Sources	Hay/Pasture	43.4
	Cropland	409.6
	Forest	3.9
	Barren Land	164.6
	Low Intensity Development	9.7
	High Intensity Residential	0.56
Instream Erosion	-	1,672.9
Total		2,304.8

4.3 Nutrient TMDL Loads

The nutrient TMDL allocation loads quantify the total amount of total phosphorus that can be assimilated by a waterbody without violating the applicable water quality standards and the distribution of the allocated loads by source category. The allocations are computed through numerical modeling and provided in *Nutrient Total Maximum Daily Load in Goose Creek Watershed, Pennsylvania*. As discussed in **Chapter 2** of the referenced document, a total phosphorus (TP) instream target concentration of 0.04 mg/L was used to make reductions of TP loads from point sources such as wastewater treatment facilities, and MS4s, and nonpoint sources.

4.4 Sediment TMDL Loads

The purpose of TMDL allocation is to identify the pollutant load reductions required from each source to achieve water quality standards. Reduction of sediment loads from each source in the impaired watershed to cumulatively meet the TMDL endpoint load is expected to ensure that Chester Creek meets water quality standards and restore its designated uses.

The point source allocation was determined based on each facility’s permitted TSS discharge limit as listed in **Table 4-4**. No reduction of the permitted TSS loads from the point source facilities is required in the TMDL. However, sediment loads from the MS4 areas require reductions that are listed in **Tables 4-8 and 4-9**. **Table 4-8** provides the allocated loads and reductions for MS4 areas by land uses, whereas **Table 4-9** provides the allocated loads and reductions for MS4 areas by municipalities.

Table 4-8: Chester Creek MS4 Areas Wasteload Allocation by Land Source

Land Source	Existing Load (ton/year)	Allocated Load (ton/year)	Reduction (%)
Hay/Pasture	160.9	121.2	24.7
Cropland	1,470.19	1,106.9	24.7
Forest	14.7	14.7	0
Barren Lands	627.14	472.2	24.7
Low Intensity Residential	139.2	104.8	24.7
High Intensity Residential	8.9	6.8	24.7
Instream Erosion	8,688.61	5,836.7	32.8
TOTAL	11,109.8	7,663.23	31.0

Table 4-9: Chester Creek MS4 Wasteload Allocation by Municipality

Municipality	Existing Load (tons/yr)	Allocated Load (tons/yr)	Percent Reduction
Aston Township	856.9	586.8	31.5%
Bethel Township	324.8	226.2	30.4%
Birmingham Township	3.8	2.6	32.5%
Brookhaven Borough	168.1	114.1	32.1%
Chadds Ford Township	44.8	31.1	30.6%
Chester Township	182.6	125.8	31.1%
Chester City	182.6	123.1	32.6%
Chester Heights Borough	434.0	298.9	31.1%
Concord Township	2,378.7	1,657.7	30.3%
East Goshen Township	623.1	428.0	31.3%
Edgmont Township	193.9	133.7	31.1%
Middletown Township	1774.5	1227.7	30.8%
Parkside Borough	12.9	8.7	32.3%
Thornbury Township (Chester County)	274.6	188.3	31.4%
Thornbury Township (Delaware County)	980.2	677.5	30.9%
Upland Borough	114.1	77.5	32.1%
Upper Chichester Township	62.2	43.0	30.9%
West Chester Borough	80.1	54.0	32.6%
West Goshen Township	1350.1	926.3	31.4%
West Whiteland Township	81.6	56.5	30.8%
Westtown Township	985.9	675.9	31.4%
TOTAL	11,109.8	7,663.2	31.0%

Additionally, sediment load reductions from land-based and instream sources by 30.6% (not including loads associated with MS4 areas, see below) are required to achieve the sediment TMDL endpoint for Chester Creek. The allocated sediment loads and the required reduction for each nonpoint source in the Chester Creek watershed are presented in **Table 4-10**. The overall load and wasteload allocations and margin of safety for the Chester Creek sediment TMDL are summarized in **Tables 4-11** and **4-12**. The daily

allocations presented in **Table 4-12** were computed by dividing the load by number of days in the year (365 days).

Table 4-10: Load Allocation for Chester Creek (not including MS4 areas)				
Source	Land Use Type	Chester Creek Sediment Load (tons/yr)		Reduction (%)
		Existing	Allocated	
Land Sources	Hay/Pasture	43.4	32.7	24.7
	Cropland	409.6	308.4	24.7
	Forest	3.9	3.9	0
	Barren Land	164.6	123.9	24.7
	Low Intensity Development	9.7	7.3	24.7
	High Intensity Residential	0.56	0.4	24.7
Instream Erosion	-	1,672.9	1,123.9	32.8
Total		2,304.8	1,600.53	30.6

Table 4-11: Sediment TMDL for Chester Creek (ton/year)			
TMDL	Load Allocation	Wasteload Allocation <i>(Includes permitted facilities and MS4 areas)</i>	Margin of Safety (10%)
11,180.1	1,600.53	8,461.56	1,118..01

Table 4-12: Sediment TMDL for Chester Creek (ton/day)			
TMDL	Load Allocation	Wasteload Allocation <i>(Includes permitted facilities and MS4 areas)</i>	Margin of Safety (10%)
30.63	4.39	23.18	3.06

Appendix A. Water Quality Data

Appendix A provides the following data used for completing the nutrient and sediment TMDL for the Chester Creek watershed:

- Water Quality observed by PADEP for development of the Draft Nutrient TMDL:
 - Instream Water Quality Data
 - Hydrologic Data
 - Sonde Measurements for DO, Temp, Spec. Conductivity, and pH
 - Discharger Water Quality Data

Table A-1: Chester Creek Low Flow TMDL Water Quality Sampling (5/24/06)

Station No.	GC-1	GC-2	GC-3	GC-4	CC-1	CC-2	CC-3	CC-4	CC-5	WBCC-1	EBCC-1
Stream	Goose Creek	Goose Creek	Goose Creek	Goose Creek	Chester Creek	W.Br. Chester	E.Br. Chester				
Date	5/24/2006	5/24/2006	5/24/2006	5/24/2006	5/24/2006	5/24/2006	5/24/2006	5/24/2006	5/24/2006	5/24/2006	5/24/2006
Time	9:00	12:00	15:15	16:00	14:55	13:25	12:25	11:05	10:30	14:30	15:30
Sample No.	137	138	139	140 & 141	109758	109759	109760	109761	109762	109756	109757
Discharge (cfs)	0.47	1.38	3.05	8.62	21.9	24.33	27.04	51.98	56.44	7.08	5.00
Temperature (oC)	12.87	16.53	17.73	17.74	17.74	15.73	15.67	14.78	15.68	15.23	17.36
Sp.Cond.(uhmos/cm)	694	763	746	631	548	513	479	428	567	344	427
DO(mg/l)	6.93	7.87	8.04	7.68	11.25	10.18	8.81	9.38	7.18	8.94	8.82
% DO	65.6	80.8	84.3	80.9	118.3	102.9	82.1	94.1	75.1	89.3	92.1
pH (su)	7.3	7.3	7.49	7.19	8.29	7.81	8.1	7.75	6.76	7.64	7.85
Alkalinity (mg/l)	112.2	140	139.4	73.6	62.2	64.8	60	58.6	46.6	54.4	67.4
TDS (mg/l)	642	630	790	481	404	464	340	374	478	278	400
TSS (mg/l)	2	6	12	8	<2	<2	<2	2	2	<2	<2
CBOD 5 Day (mg/l)	1.90*	2.10*	1.7	1.8***	*****	*****	*****	*****	*****	*****	*****
CBOD 20Day (mg/l)	2.9	11.2	5.5	7.7	4.0	3.6***	2.60***	*****	*****	2.70****	3.00****
Total P (ug/l)	38	1514	1084	1582.5	856	789	605	384	373	70	21
Diss P (ug/l)	17	1517	942	1533.5	798	738	579	349	263	56	22
Total Ortho P (ug/l)	36	1521	1063	1507.5	756	731	582	363	266	64	15
Dissolved Ortho P (ug/l)	26	1326	873	1406.5	746	716	561	337	246	55	15
Total Nitrogen (ug/l)	3160	7630	6380	15385	9360	8720	7550	5490	13220	2160	1900
NO3-N(ug/l)	2890	6440	4630	12460	8110	7200	5870	3250	11460	1970	1720
NO2-N (ug/l)	40	50	70	160	80	70	40	30	50	<10	10
NH3-N (ug/l)	90	330	290	315	30	40	30	60	320	<20	20

* CBOD - laboratory indicates <2.0 mg/l DO depletion

*** Standard out of range. Results may be biased low

**** Standard out of range. Results may be biased high

***** test missed by PA DEP Lab

CC-5, SWDC STP not mixed prior to tidal influence, 3 point composite

Table A-2: Chester Creek Low Flow TMDL Water Quality Sampling (6/01/06)

Station No.	GC-1	GC-2	GC-3	GC-4	CC-1	CC-2	CC-3	CC-4	CC-5	WBCC-1	EBCC-1
Stream	Goose Creek	Goose Creek	Goose Creek	Goose Creek	Chester Creek	W.Br. Chester	E.Br. Chester				
Date	8/1/2006	8/1/2006	8/1/2006	8/1/2006	8/1/2006	8/1/2006	8/1/2006	8/1/2006	8/1/2006	8/1/2006	8/1/2006
Time	17:45	17:20	16:30	16:00	14:15	13:00	12:20	10:00	9:00	11:20	15:00
Sample No.	0109792	0109791	0109790	0109789	dup, see QA	0109786	0109785	0109783	0109782	0109784	0109788
Discharge (cfs)	0.74	2.73	2.96	10.58	22.55	23.50	24.70	46.44	58.18	6.33	4.81
Temperature (oC)	25.89	27.27	27.07	25.22	27.16	25.53	26.00	25.19	25.03	24.26	27.82
Sp.Cond.(uhmos/cm)	750	857	853	706	548	524	469	401	410	357	362
DO(mg/l)	7.41	7.76	7.45	7.18	10.33	9.40	9.02	8.22	7.68	9.18	8.77
% DO	92	98	94	87	130	115	111	100	93	110	112
pH (su)	7.79	7.58	7.47	7.00	7.85	7.62	7.95	7.68	7.61	7.81	7.46
Alkalinity (mg/l)	128	116	122	50	53	56	59	57	56	60	64
TDS (mg/l)	652	668	662	616	438	422	410	326	338	290	332
TSS (mg/l)	<2	4	<2	<2	2	6	6	6	<2	2	2
CBOD 5 Day (mg/l)	2.3*	1.5	1.4	1.0	1.2	1.2	1.1	1.0***	1.1***	2.2*	1.2
CBOD 20Day (mg/l)	1.6	3.4	3.5	2.5	2.1	2.7	2.0	1.3	1.5	0.9	3.7
Total P (ug/l)	67	2402	1812	1712	834	821	581	325	534	88	65
Diss P (ug/l)	45	2295	1554	1625	830	742	537	301	479	71	28
Total Ortho P (ug/l)	49	2282	1533	1549	772	730	530	298	484	82	22
Dissolved Ortho P (ug/l)	38	2226	1409	1538	754	722	512	288	467	71	17
Total Nitrogen (ug/l)	3050	11370	9660	18760	11820	10620	7050	4790	5750	2100	1350
NO3-N(ug/l)	2710	9530	8080	16900	10580	9420	6490	4810	4760	1950	860
NO2-N (ug/l)	20	<0.01	40	180	75	60	20	20	20	<10	<10
NH3-N (ug/l)	60	40	210	320	35	50	20	40	90	<20	60

* CBOD - laboratory indicates <2.0 mg/l DO depletion

*** Standard out of range. Results may be biased low

**** Standard out of range. Results may be biased high

***** test missed by PA DEP Lab

CC-5, SWDC STP not mixed prior to tidal influence, 3 point composite

Table A-3: Measured Flow on May 24, 2006

Station CC-1					Station CC-2				
Date	5/24/2006				Date	5/24/2006			
Creek	Chester				Creek	Chester			
Width(ft)	40				Width(ft)	34			
Flow(cfs)	21.92				Flow(cfs)	24.33			
Midpoint	Cell Length (ft)	Depth(ft)	Velocity (ft/sec)	Cell Flow (cfs)	Midpoint	Cell Length (ft)	Depth(ft)	Velocity (ft/sec)	Cell Flow (cfs)
0		0			2		0		
1	2	1.1	0.2	0.44	4	2	0.2	0.15	0.06
3	2	1.6	0.29	0.928	6	2	0.5	0.17	0.17
5	2	1.7	0.31	1.054	8	2	0.6	0.35	0.42
7	2	1.7	0.36	1.224	10	2	0.8	0.56	0.896
9	2	1.5	0.45	1.35	12	2	0.9	0.73	1.314
11	2	1.5	0.54	1.62	14	2	1	1	2
13	2	1.5	0.56	1.68	16	2	1.1	1.03	2.266
15	2	1.5	0.54	1.62	18	2	1	1.12	2.24
17	2	1.5	0.6	1.8	20	2	1.1	1.14	2.508
19	2	1.45	0.54	1.566	22	2	1	1.04	2.08
21	2	1.4	0.53	1.484	24	2	1.1	0.95	2.09
23	2	1.5	0.54	1.62	26	2	1	0.94	1.88
25	2	1.3	0.55	1.43	28	2	1.1	0.95	2.09
27	2	1.15	0.45	1.035	30	2	1	0.7	1.4
29	2	0.8	0.54	0.864	32	2	0.85	0.79	1.343
31	2	0.8	0.5	0.8	34	2	0.7	0.95	1.33
33	2	1	0.5	1	36	2	0.6	0.2	0.24
35	2	0.8	0.1	0.16	37		0		
37	2	0.5	0.1	0.1					
39	2	0.5	0.15	0.15					
discharge				21.925	discharge				24.327

Table A-4: Measured Flow on May 24, 2006

Station CC-3					Station CC-4				
Date 5/24/2006					Date 5/24/2006				
Creek Chester					Creek Chester				
Width(ft) 30					Width(ft) 72				
Flow(cfs) 27.04					Flow(cfs) 51.98				
Midpoint	Cell Length (ft)	Depth(ft)	Velocity (ft/sec)	Cell Flow (cfs)	Midpoint	Cell Length (ft)	Depth(ft)	Velocity (ft/sec)	Cell Flow (cfs)
7		0			4		0		
8	2	0.65	0.34	0.442	6	4	0.5	0.09	0.18
10	2	0.8	0.75	1.2	10	4	1.25	0.62	3.1
12	2	1.3	0.93	2.418	14	4	1.1	0.62	2.728
14	2	1.5	0.61	1.83	18	4	0.9	0.85	3.06
16	2	1.7	0.71	2.414	22	4	0.8	0.9	2.88
18	2	1.85	0.92	3.404	26	4	0.8	1	3.2
20	2	1.7	0.95	3.23	30	4	0.8	0.96	3.072
22	2	1.6	1.07	3.424	34	4	0.8	1.08	3.456
24	2	1.4	1.03	2.884	38	4	0.9	0.98	3.528
26	2	1.35	1.13	3.051	42	4	0.8	0.75	2.4
28	2	1.1	0.86	1.892	46	4	0.8	0.82	2.624
30	2	0.7	0.55	0.77	50	4	0.8	1.02	3.264
32	2	0.3	0.21	0.126	54	4	0.8	0.91	2.912
34	2	0.2	-0.1	-0.04	58	4	0.8	1.05	3.36
36	2	0.1	0	0	62	4	0.8	1.01	3.232
37		0		0	66	4	0.9	1.05	3.78
					70	4	1.15	0.93	4.278
					74	4	0.8	0.29	0.928
					76		0		
discharge				27.045	discharge				51.982

Table A-5: Measured Flow on May 24, 2006

Station CC-4					Station CC-5				
Date	5/24/2006				Date	5/24/2006			
Creek	Chester				Creek	Chester			
Width(ft)	72				Width(ft)	63			
Flow(cfs)	51.98				Flow(cfs)	56.44			
Midpoint	Cell Length (ft)	Depth(ft)	Velocity (ft/sec)	Cell Flow (cfs)	Midpoint	Cell Length (ft)	Depth(ft)	Velocity (ft/sec)	Cell Flow (cfs)
4		0			0.5		0		
6	4	0.5	0.09	0.18	2	3	0.8	0.18	0.432
10	4	1.25	0.62	3.1	5	3	1.1	0.5	1.65
14	4	1.1	0.62	2.728	8	3	1.1	0.6	1.98
18	4	0.9	0.85	3.06	11	3	1.3	0.3	1.17
22	4	0.8	0.9	2.88	14	3	1.35	0.54	2.187
26	4	0.8	1	3.2	17	3	1.5	0.81	3.645
30	4	0.8	0.96	3.072	20	3	1.5	0.7	3.15
34	4	0.8	1.08	3.456	23	3	1.4	1.08	4.536
38	4	0.9	0.98	3.528	26	3	1.3	1.07	4.173
42	4	0.8	0.75	2.4	29	3	1.3	1.2	4.68
46	4	0.8	0.82	2.624	32	3	1.2	1.29	4.644
50	4	0.8	1.02	3.264	35	3	1.1	1.3	4.29
54	4	0.8	0.91	2.912	38	3	1.15	1.2	4.14
58	4	0.8	1.05	3.36	41	3	1.15	1.22	4.209
62	4	0.8	1.01	3.232	44	3	1	1.2	3.6
66	4	0.9	1.05	3.78	47	3	0.95	1.19	3.3915
70	4	1.15	0.93	4.278	50	3	0.8	1	2.4
74	4	0.8	0.29	0.928	53	3	0.6	0.77	1.386
76		0			56	3	0.4	0.6	0.72
					59	3	0.2	0.1	0.06
					62	3	0	0	0
					63.5		0		
discharge				51.982	discharge				56.4435

Table A-6: Measured Flow on May 24, 2006

Station WBCC-1					Station EBCC-1				
Date 5/24/2006					Date 5/24/2006				
Creek West Branch Chester					Creek E.Br. Chester				
Width(ft) 20					Width(ft) 22				
Flow(cfs) 7.08					Flow(cfs) 5.00				
Midpoint	Cell Length (ft)	Depth(ft)	Velocity (ft/sec)	Cell Flow (cfs)	Midpoint	Cell Length (ft)	Depth(ft)	Velocity (ft/sec)	Cell Flow (cfs)
3		0			2		0		
3.5	1	0.3	0.35	0.105	2.5	1	0.1	0	0
4.5	1	0.7	0.38	0.266	3.5	1	0.1	0	0
5.5	1	0.7	0.46	0.322	4.5	1	0.3	0.03	0.009
6.5	1	0.8	0.5	0.4	5.5	1	0.3	0.35	0.105
7.5	1	1.3	0.47	0.611	6.5	1	0.5	0.27	0.135
8.5	1	1.2	0.45	0.54	7.5	1	0.6	0.06	0.036
9.5	1	1.2	0.48	0.576	8.5	1	0.55	0.49	0.2695
10.5	1	1.25	0.53	0.6625	9.5	1	0.7	0.33	0.231
11.5	1	1.2	0.54	0.648	10.5	1	0.7	0.32	0.224
12.5	1	1.2	0.55	0.66	11.5	1	0.85	0.4	0.34
13.5	1	1.15	0.52	0.598	12.5	1	1	0.34	0.34
14.5	1	1.1	0.44	0.484	13.5	1	0.95	0.43	0.4085
15.5	1	1.1	0.3	0.33	14.5	1	0.8	0.5	0.4
16.5	1	0.9	0.38	0.342	15.5	1	1.1	0.45	0.495
17.5	1	0.8	0.38	0.304	16.5	1	1.1	0.41	0.451
18.5	1	0.65	0.22	0.143	17.5	1	1.1	0.48	0.528
19.5	1	0.45	0.12	0.054	18.5	1	0.9	0.49	0.441
20.5	1	0.4	0.04	0.016	19.5	1	0.85	0.38	0.323
21.5	1	0.3	0.05	0.015	20.5	1	0.6	0.25	0.15
22.5	1	0.1	0	0	21.5	1	0.4	0.18	0.072
23		0		0	22.5	1	0.2	0.22	0.044
					23.5	1	0.1	0	0
					24		0		
discharge				7.0765	discharge				5.002

Table A-7: Measured Flow on August 1, 2006

Station GC-1					Station GC-2				
Date	8/1/2006				Date	8/1/2006			
Creek	Goose Creek				Creek	Goose Creek			
Width(ft)	12				Width(ft)	13			
Flow(cfs)	0.74				Flow(cfs)	2.05			
	Cell Length (ft)	Depth(ft)	Velocity (ft/sec)	Cell Flow (cfs)		Cell Length (ft)	Depth(ft)	Velocity (ft/sec)	Cell Flow (cfs)
Midpoint					Midpoint				
6.5	1	0.1	0	0	1.5	1	0.7	0.17	0.119
7.5	1	0.2	0.27	0.054	2.5	1	0.55	0.23	0.1265
8.5	1	0.2	0.3	0.06	3.5	1	0.6	0.15	0.09
9.5	1	0.3	0.42	0.126	4.5	1	0.6	0.24	0.144
10.5	1	0.35	0.45	0.1575	5.5	1	0.7	0.17	0.119
11.5	1	0.3	0.41	0.123	6.5	1	0.8	0.34	0.272
12.5	1	0.2	0.4	0.08	7.5	1	0.9	0.45	0.405
13.5	1	0.2	0.26	0.052	8.5	1	0.9	0.36	0.324
14.5	1	0.2	0.28	0.056	9.5	1	0.9	0.23	0.207
15.5	1	0.15	0.23	0.0345	10.5	1	0.7	0.1	0.07
16.5	1	0.15	0	0	11.5	1	0.7	0.11	0.077
17.5	1	0.1	0	0	12.5	1	0.5	0.13	0.065
				0	13.5	1	0.2	0.15	0.03
				0					0
				0					0
				0					0
				0					0
				0					0
				0					0
				0					0
				0					0
				0					0
				0					0
				0					0
				0					0
				0					0
				0					0
				0					0
				0					0
discharge				0.743	discharge				2.0485

Table A-9: Measured Flow on August 1, 2006

Station GC-4					Station CC-1				
Date	8/1/2006				Date	8/1/2006			
Creek	Goose Creek				Creek	Chester Creek			
Width(ft)	17.5				Width(ft)	41			
Flow(cfs)	10.58				Flow(cfs)	22.55			
Midpoint	Cell Length (ft)	Depth(ft)	Velocity (ft/sec)	Cell Flow (cfs)	Midpoint	Cell Length (ft)	Depth(ft)	Velocity (ft/sec)	Cell Flow (cfs)
1.5	1	1.2	0.46	0.552	1	2	0.7	0.39	0.546
2.5	1	1.2	0.61	0.732	3	2	0.9	0.41	0.738
3.5	1	1.3	0.45	0.585	5	2	1.15	0.4	0.92
4.5	1	1.25	0.18	0.225	7	2	1.15	0.54	1.242
5.5	1	1.45	0.43	0.6235	9	2	1.5	0.54	1.62
6.5	1	1.3	0.45	0.585	11	2	1.54	0.44	1.3552
7.5	1	1.2	0.42	0.504	13	2	1.85	0.66	2.442
8.5	1	1.3	0.51	0.663	15	2	1.65	0.69	2.277
9.5	1	1.1	0.38	0.418	17	2	1.05	0.66	1.386
10.5	1	1.5	0.86	1.29	19	2	1.25	0.65	1.625
11.5	1	1.5	0.68	1.02	21	2	1.4	0.57	1.596
12.5	1	1.3	0.86	1.118	23	2	1.35	0.56	1.512
13.5	1	1.4	0.79	1.106	25	2	1.2	0.52	1.248
14.5	1	1.35	0.29	0.3915	27	2	1	0.43	0.86
15.5	1	1.45	0.18	0.261	29	2	0.85	0.48	0.816
16.5	1	1.4	0.27	0.378	31	2	0.65	0.44	0.572
17.5	1	1.1	0.1	0.11	33	2	0.82	0.52	0.8528
18.25	0.5	1	0.03	0.015	35	2	0.8	0.16	0.256
				0	37	2	0.6	0.23	0.276
				0	39	2	0.5	0.4	0.4
				0	40.5	1	0.6	0.02	0.012
				0					0
discharge	10.577				discharge	22.552			

Table A-10: Measured Flow on August 1, 2006

Station CC-2					Station CC-3				
Date	8/1/2006				Date	8/1/2006			
Creek	Chester Creek				Creek	Chester Creek			
Width(ft)	31				Width(ft)	28			
Flow(cfs)	23.50				Flow(cfs)	24.70			
Midpoint	Cell Length (ft)	Depth(ft)	Velocity (ft/sec)	Cell Flow (cfs)	Midpoint	Cell Length (ft)	Depth(ft)	Velocity (ft/sec)	Cell Flow (cfs)
8	2	0.1	0	0	15	2	0.1	0	0
10	2	0.4	0.16	0.128	17	2	0.25	0.15	0.075
12	2	0.7	0.54	0.756	19	2	0.65	0.37	0.481
14	2	0.8	0.88	1.408	21	2	0.9	0.69	1.242
16	2	0.9	0.97	1.746	23	2	1.2	0.86	2.064
18	2	1	1.03	2.06	25	2	1.45	0.97	2.813
20	2	0.9	1.1	1.98	27	2	1.4	1.1	3.08
22	2	1.05	1.19	2.499	29	2	1.4	1.07	2.996
24	2	1.1	1.18	2.596	31	2	1.6	0.92	2.944
26	2	1.1	1.01	2.222	33	2	1.5	1.13	3.39
28	2	1	0.97	1.94	35	2	1.2	0.94	2.256
30	2	1	1	2	37	2	1.15	0.79	1.817
32	2	0.8	0.97	1.552	39	2	0.85	0.76	1.292
34	2	0.8	0.86	1.376	41	2	0.6	0.21	0.252
36	2	0.75	0.8	1.2					0
37.5	1	0.6	0.07	0.042					0
				0					0
				0					0
				0					0
				0					0
				0					0
				0					0
				0					0
				0					0
				0					0
discharge				23.505	discharge				24.702

Table A-11: Measured Flow on August 1, 2006

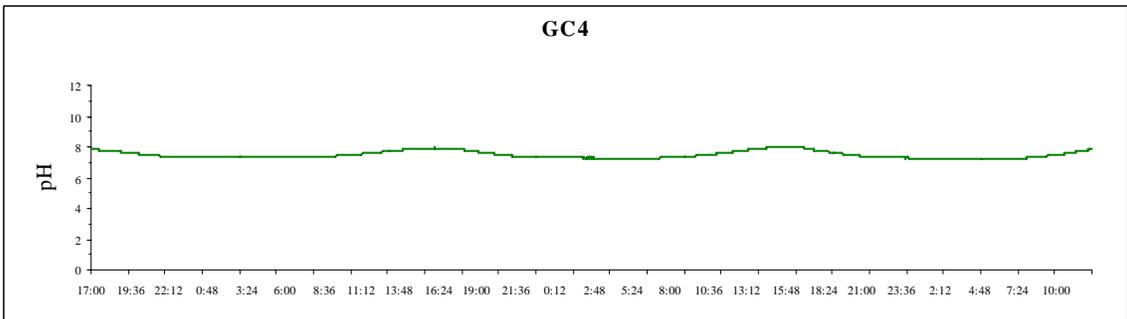
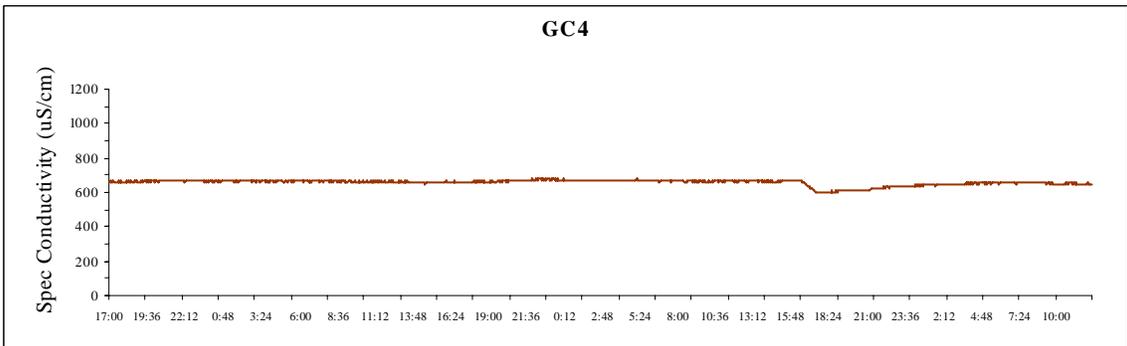
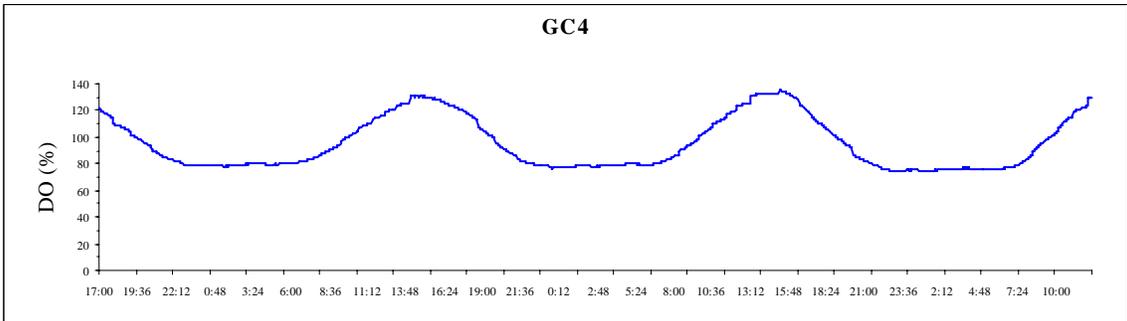
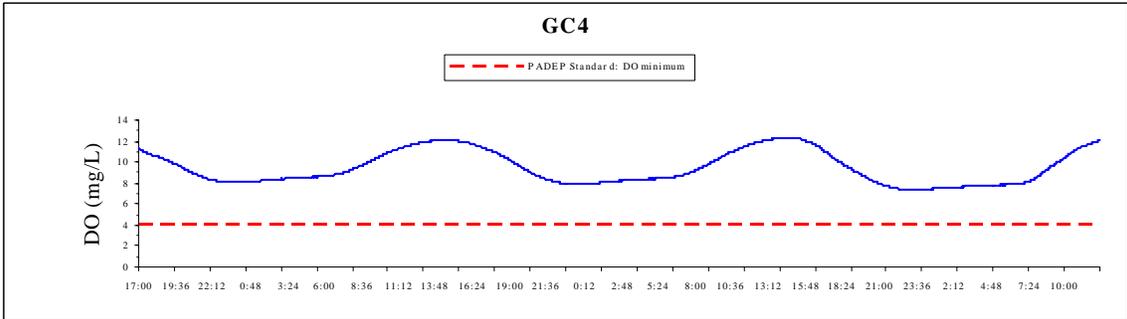
Station CC-4					Station CC-5				
Date	8/1/2006				Date	8/1/2006			
Creek	Chester Creek				Creek	Chester Creek			
Width(ft)	71				Width(ft)	62			
Flow(cfs)	46.44				Flow(cfs)	58.18			
Midpoint	Cell Length (ft)	Depth(ft)	Velocity (ft/sec)	Cell Flow (cfs)	Midpoint	Cell Length (ft)	Depth(ft)	Velocity (ft/sec)	Cell Flow (cfs)
6	4	0.9	0.05	0.18	5	4	0.7	0.22	0.616
10	4	1.1	0.77	3.388	9	4	1.15	0.36	1.656
14	4	1	0.55	2.2	13	4	1.4	0.25	1.4
18	4	0.75	0.85	2.55	17	4	1.37	0.63	3.4524
22	4	0.7	1.11	3.108	21	4	1.94	0.95	7.372
26	4	0.8	1	3.2	25	4	1.85	1.13	8.362
30	4	0.75	0.95	2.85	29	4	1.3	1.08	5.616
34	4	0.75	1.1	3.3	33	4	1.15	1.03	4.738
38	4	0.7	1.09	3.052	37	4	1.1	1.01	4.444
42	4	0.6	0.96	2.304	41	4	1.1	0.99	4.356
46	4	0.6	1	2.4	45	4	1.05	1.34	5.628
50	4	0.65	0.75	1.95	49	4	1.05	1.28	5.376
54	4	0.7	0.9	2.52	53	4	0.84	0.94	3.1584
58	4	0.8	0.98	3.136	57	4	0.53	0.77	1.6324
62	4	0.8	1.07	3.424	61	4	0.3	0.26	0.312
66	4	1	1.1	4.4	64	2	0.2	0.16	0.064
70	4	1	0.48	1.92					0
73.5	3	0.75	0.25	0.5625					0
				0					0
				0					0
				0					0
				0					0
discharge				46.4445	discharge				58.1832

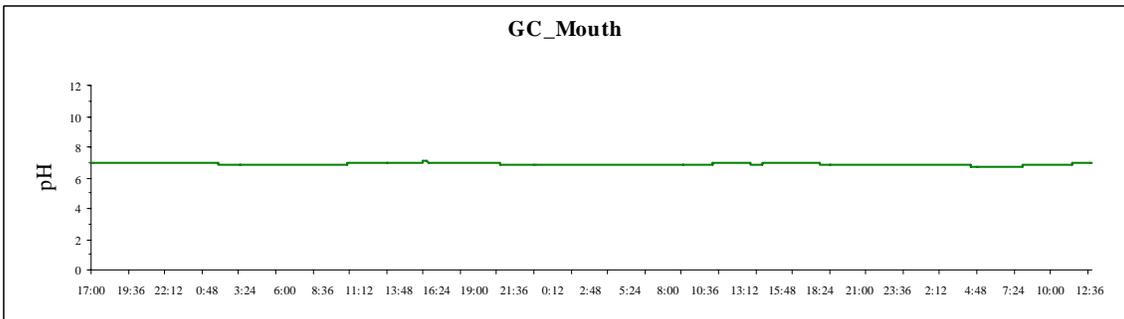
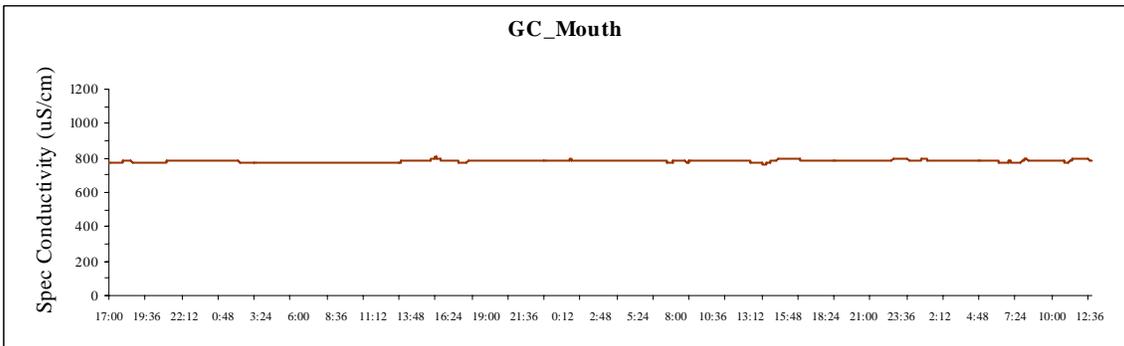
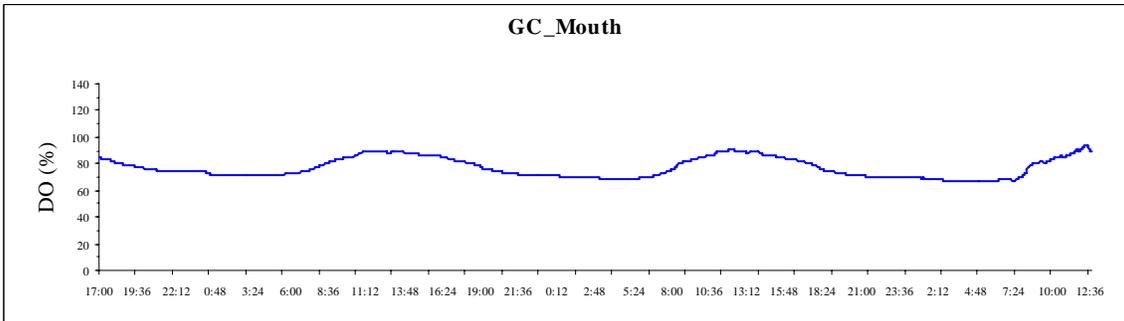
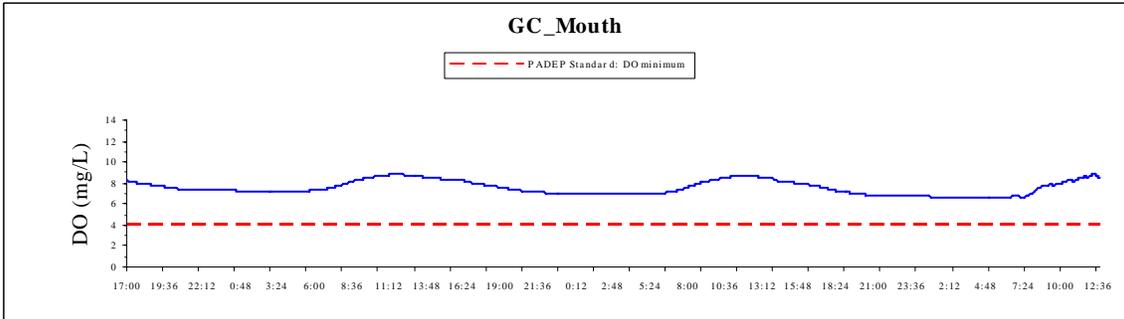
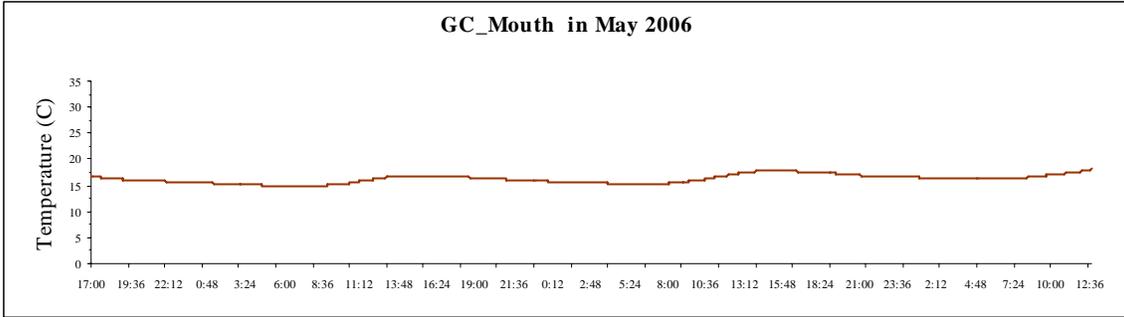
Table A-12: Measured Flow on August 1, 2006

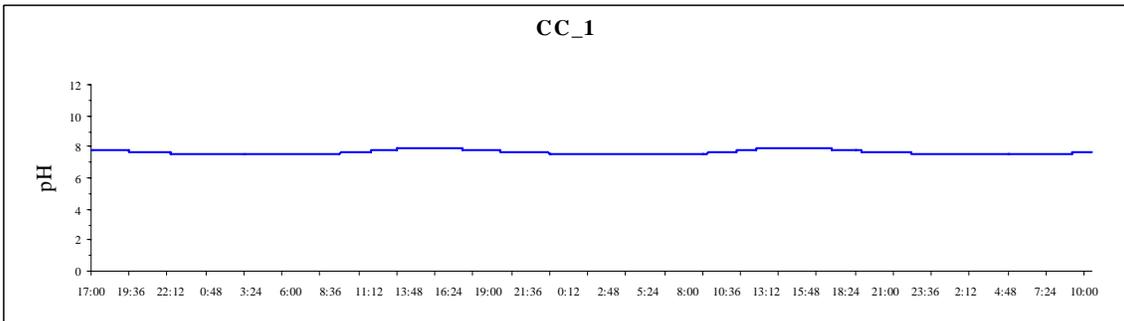
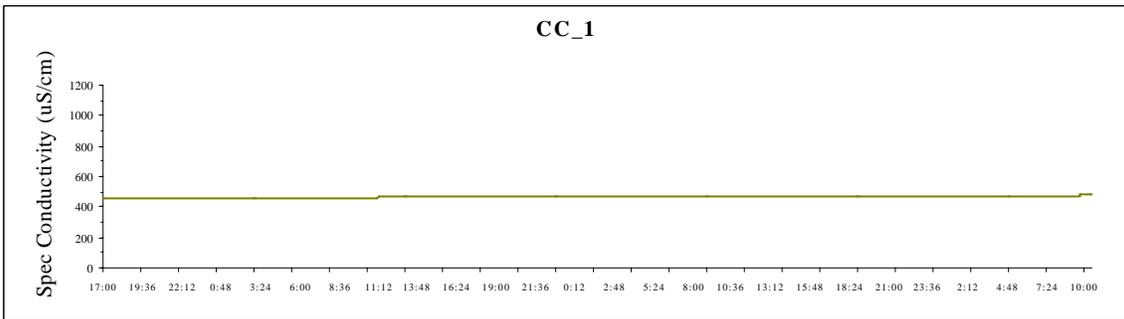
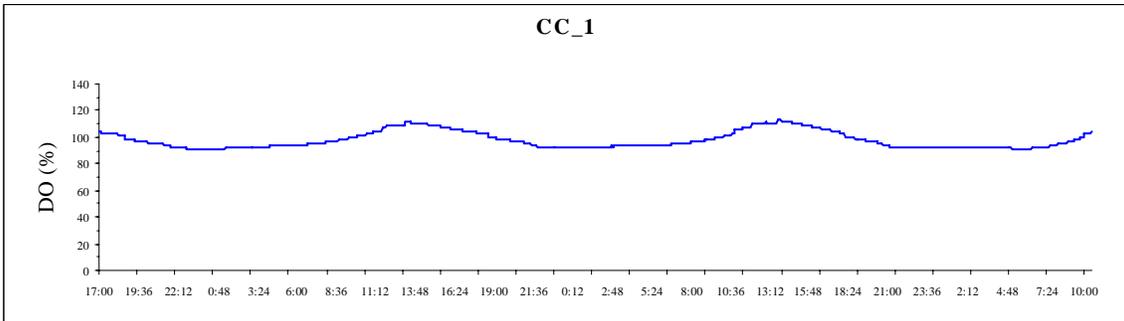
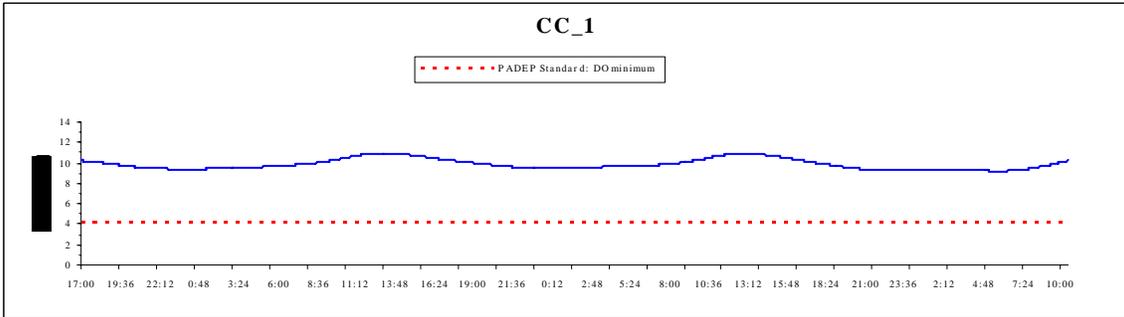
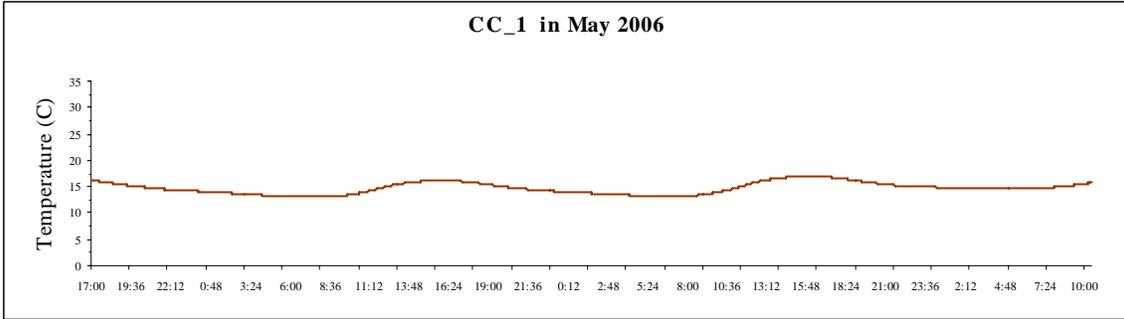
Station WBCC-1					Station EBCC-1				
Date 8/1/2006					Date 8/1/2006				
Creek W.B. Chester Creek					Creek E.B. Chester Creek				
Width(ft) 23					Width(ft) 22				
Flow(cfs) 6.33					Flow(cfs) 4.81				
	Cell			Cell				Cell	
	Length		Velocity	Flow		Cell	Velocity	Flow	
Midpoint	(ft)	Depth(ft)	(ft/sec)	(cfs)	Midpoint	(ft)	(ft/sec)	(cfs)	
4.5	1	0.15	0	0	8.5	1	0.2	0	0
5.5	1	0.2	-0.05	-0.01	9.5	1	0.3	0.24	0.072
6.5	1	0.25	-0.02	-0.005	10.5	1	0.4	0.27	0.108
7.5	1	0.4	0.06	0.024	11.5	1	0.4	0.3	0.12
8.5	1	0.5	0.05	0.025	12.5	1	0.85	0.31	0.2635
9.5	1	0.4	0.18	0.072	13.5	1	1	0.42	0.42
10.5	1	0.6	0.34	0.204	14.5	1	1.2	0.4	0.48
11.5	1	0.75	0.31	0.2325	15.5	1	1.1	0.37	0.407
12.5	1	0.8	0.4	0.32	16.5	1	1.1	0.36	0.396
13.5	1	0.75	0.47	0.3525	17.5	1	1.1	0.35	0.385
14.5	1	0.9	0.38	0.342	18.5	1	0.95	0.4	0.38
15.5	1	0.95	0.42	0.399	19.5	1	1	0.4	0.4
16.5	1	1	0.4	0.4	20.5	1	0.8	0.39	0.312
17.5	1	1.25	0.45	0.5625	21.5	1	0.6	0.39	0.234
18.5	1	1.35	0.42	0.567	22.5	1	0.7	0.37	0.259
19.5	1	1.45	0.4	0.58	23.5	1	0.7	0.22	0.154
20.5	1	1.3	0.41	0.533	24.5	1	0.5	0.07	0.035
21.5	1	1.2	0.42	0.504	25.5	1	0.55	0.3	0.165
22.5	1	1.1	0.34	0.374	26.5	1	0.35	0.47	0.1645
23.5	1	1	0.36	0.36	27.5	1	0.3	0.19	0.057
24.5	1	0.8	0.4	0.32	28.5	1	0.2	0	0
25.5	1	1	0.13	0.13	29.5	1	0.3	0	0
26.5	1	0.8	0.05	0.04					
discharge				6.3265	discharge				4.812

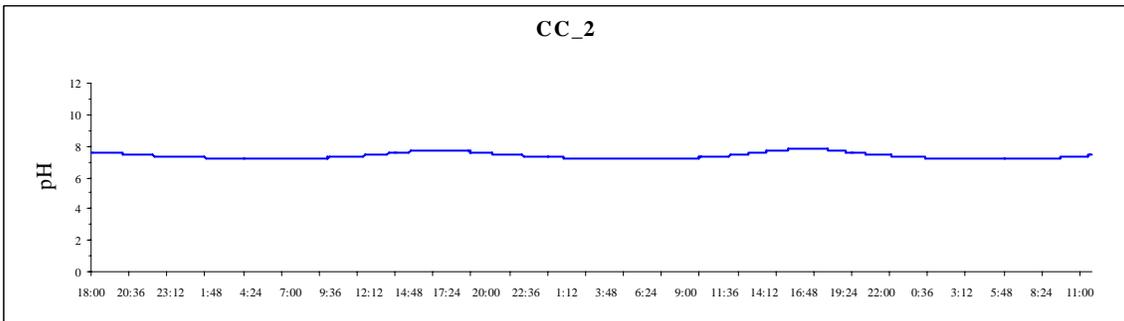
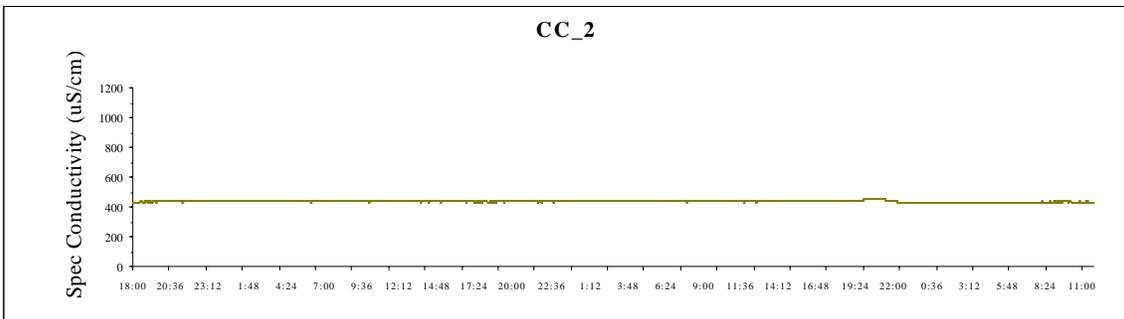
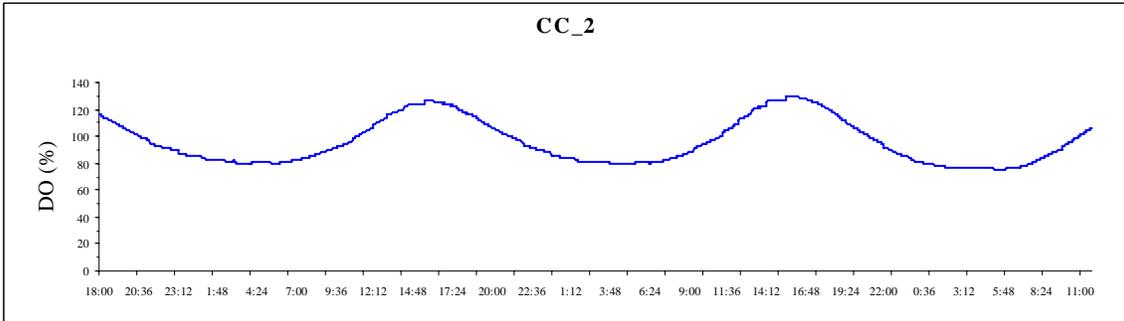
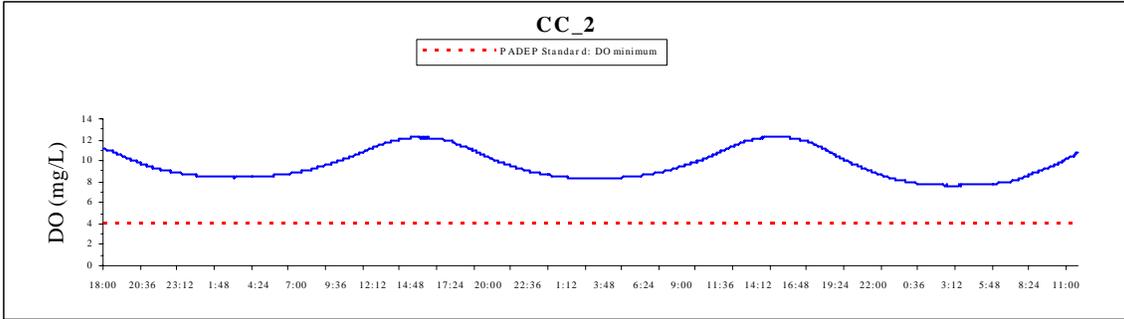
Table A-13: Hydraulic Data Summary

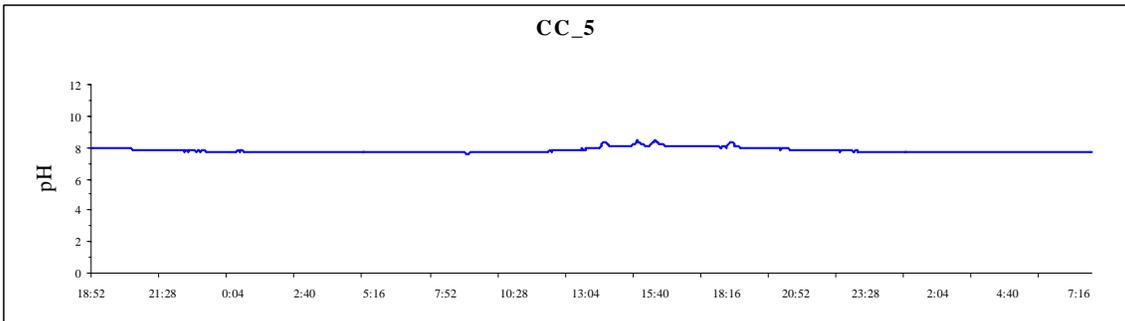
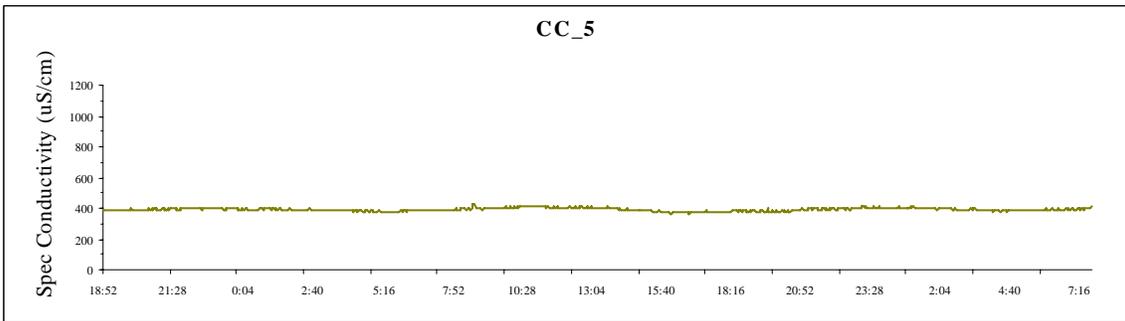
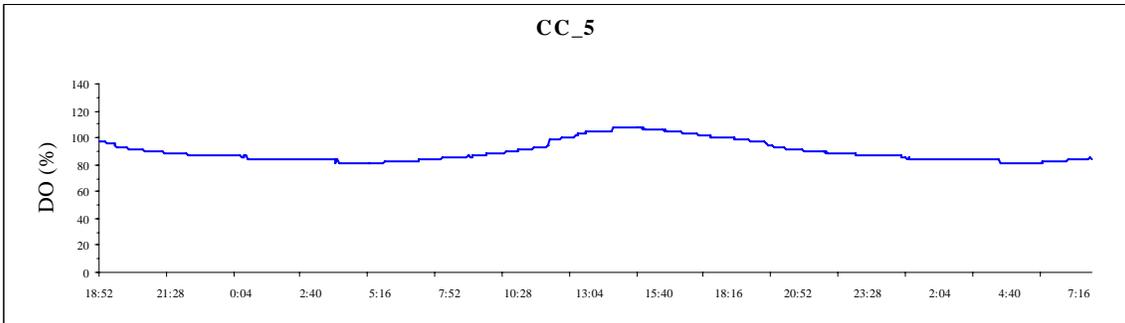
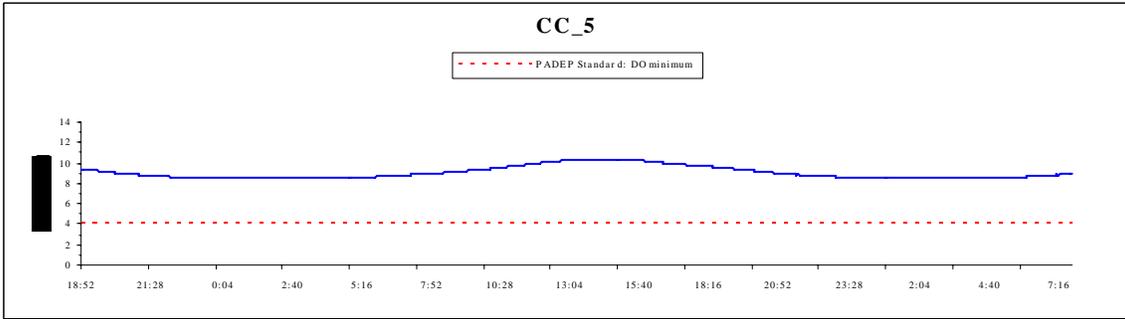
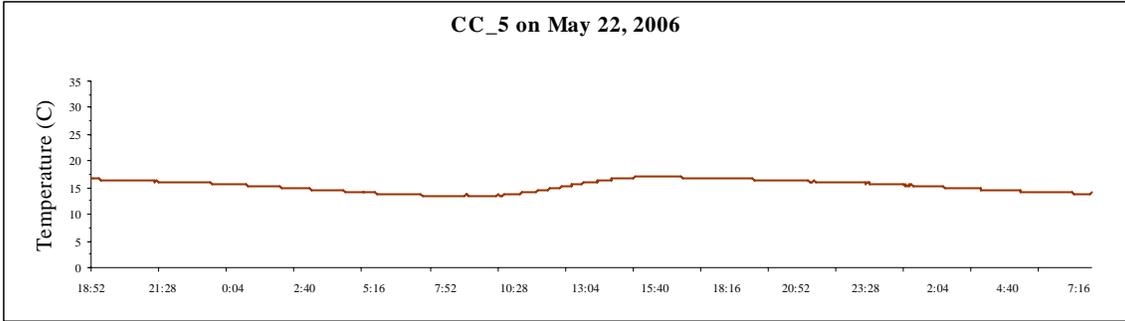
Station	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	H11	H12	H13
Stream	EBCC	EBCC	Goose	Goose	EBCC	Chester	Chester	Chester	Rocky	Rocky	Chester	WBCC	Chester
Date	5/10/2006	5/10/2006	3/31/2006	9/13/2005	4/18/2006	5/9/2006	9/13/2005	10/16/2006	9/12/2005	9/12/2005	10/27/2006	10/26/2006	10/27/2006
Time	1300	950	1300	1530	1130	1400	1200	1315	1600	1400	900	1100	1400
Bankfull Width(ft)	17	31	24	27	25	40	50	55	16	40	54	45	79
Bandfull X 20 (ft)	340	620	480	540	500	800	1000	1100	320	800	1080	900	1580
XS Spacing (ft)	48.6	89	60	67.5	71	114	125	157	40	100	154.3	129	225.7
Discharge (cfs)	2.83	4.16	0.96	8.94	9.02	21.6	14.3	25.243	0.68	0.91	34.01	17.32	52.06
Segment Length	340	623	420	540	497	798	1000	1100	320	800	1080	900	1580
Lat.	39 58 58.8	39 57 31.4	39 57 10.9	39 55 59.4	39 55 58.4	39 55 46.1	39 55 56.0	39 54 41.5	39 55 12.3	39 54 10.6	39 53 32.8	39 52 38.7	39 52 47.1
Long.	75 33 42.1	75 32 44.1	75 35 19.7	75 33 26.8	75 32 34.2	75 31 59.6	75 30 39.6	75 28 49.9	75 27 5.4	75 27 45.9	75 26 41.1	75 26 58.8	75 25 37.35
Lat.	39 59 1.2	39 57 36.6	39 57 16.6	39 56 4.9	39 56 3.9	39 55 49.1	39 55 54.8	39 54 47.9	39 55 16.1	39 54 16.9	39 53 33.5	39 52 32.9	39 53 00.45
Long.	75 33 43.2	75 32 42.3	75 35 21.0	75 33 30.5	75 32 30.3	75 32 7.1	75 30 56.6	75 28 58.5	75 27 5.3	75 27 46.5	75 26 55.3	75 27 8.6	75 25 45.65
Average Velocity (ft/sec)	0.387	0.414	0.057	0.471	0.673	0.539	0.506	0.397	0.142	0.244	0.485	0.330	0.670
Average Surface Width (ft)	8.6	21.6	19.2	22.5	20.5	34	38.5	46.2	9.1	15.3	49.5	45.7	59.7
Average XS Area(ft²)	7.32	10.04	16.91	19	13.41	40.06	28.25	63.52	4.78	3.73	70.18	52.48	77.7
Mean Depth (ft)	0.851	0.465	0.881	0.844	0.654	1.178	0.734	1.375	0.525	0.244	1.418	1.148	1.302
Average Wetted Perimeter (ft)	10.30	22.53	20.96	24.19	21.81	36.36	39.97	48.95	10.15	15.79	52.34	48.00	62.30
Average Hydraulic Radius (ft)	0.711	0.446	0.807	0.785	0.615	1.102	0.707	1.298	0.471	0.236	1.341	1.093	1.247

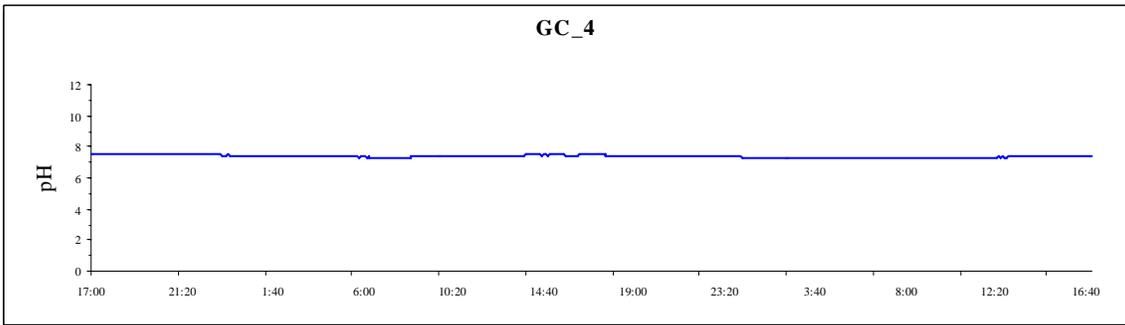
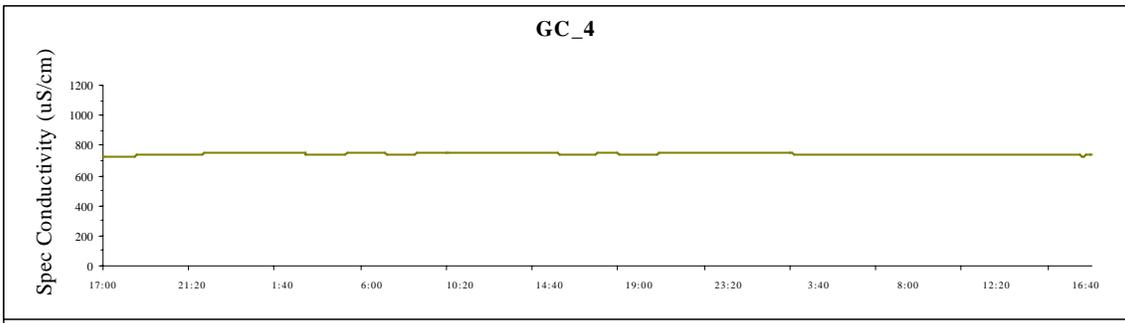
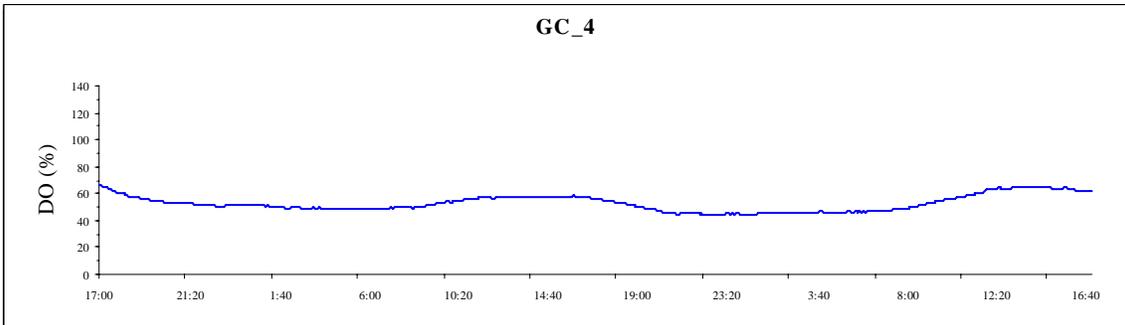
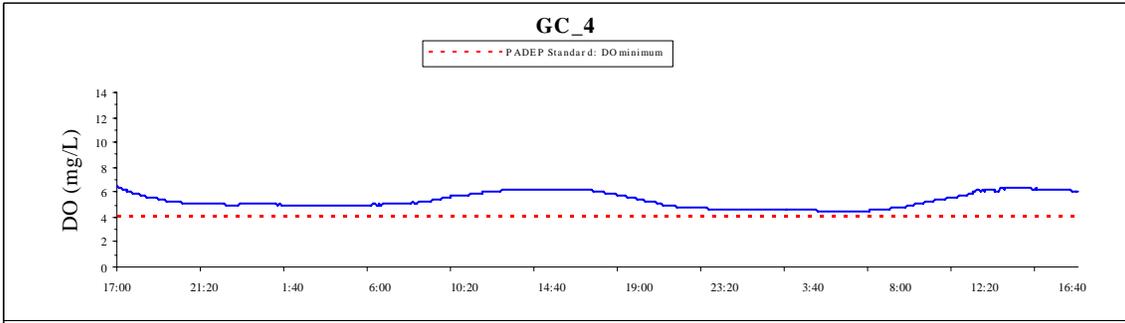
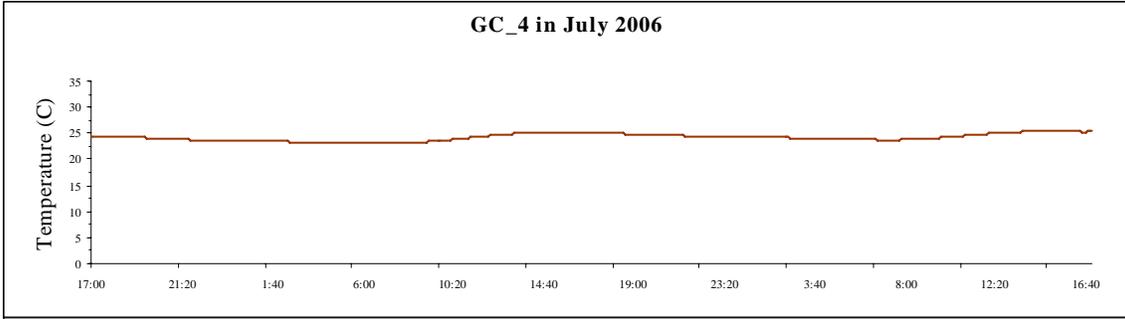


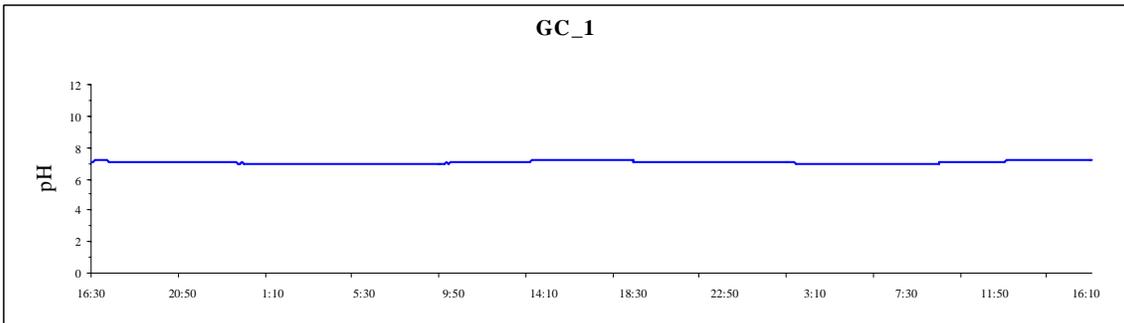
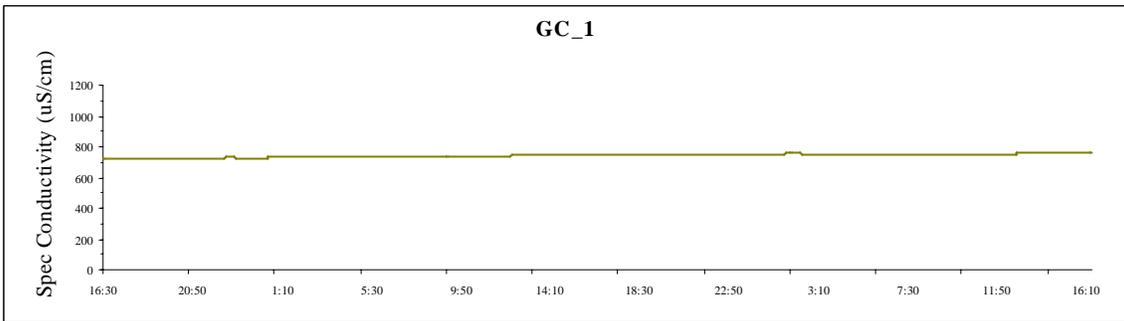
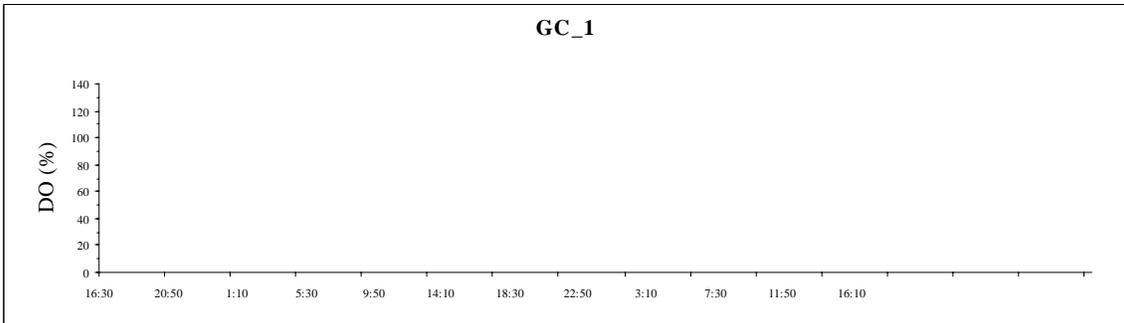
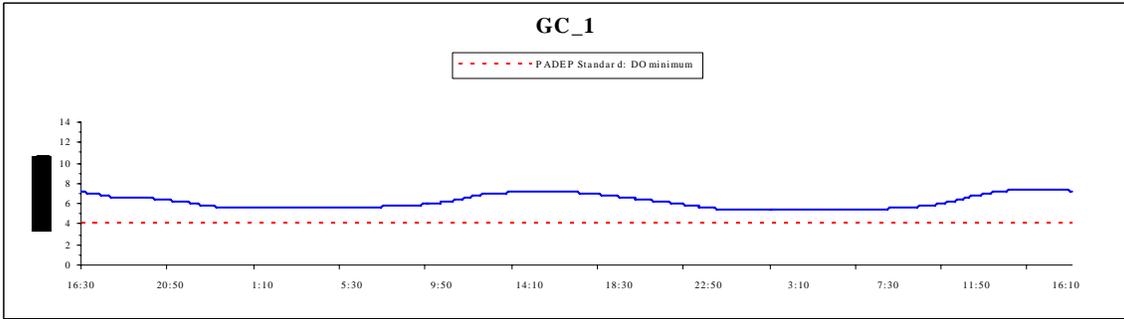












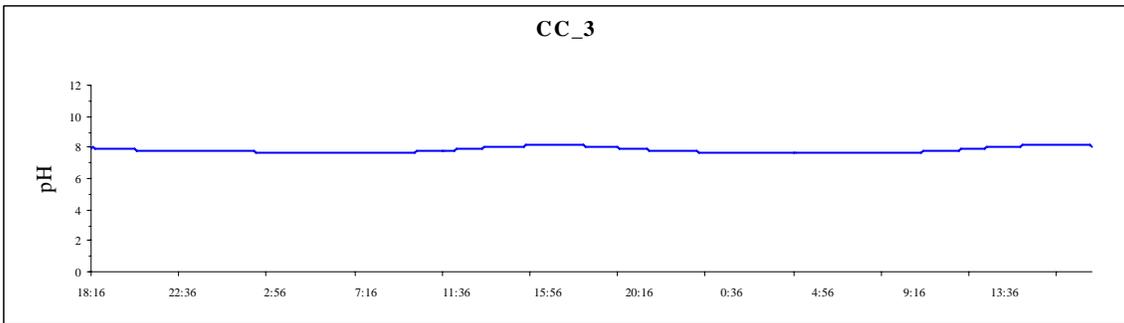
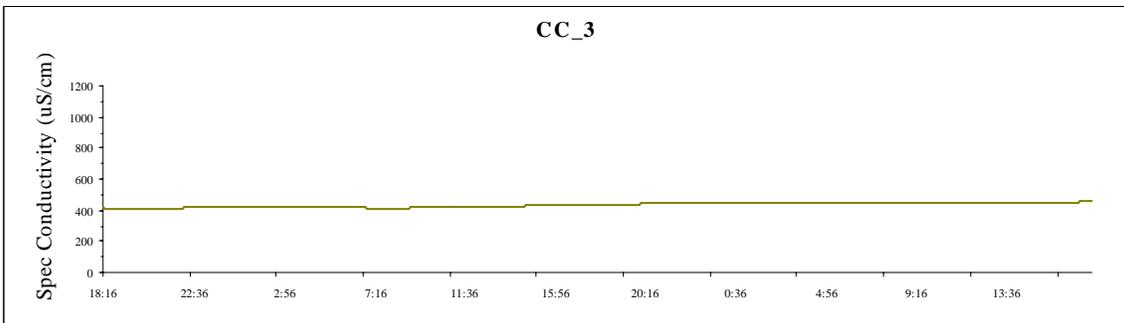
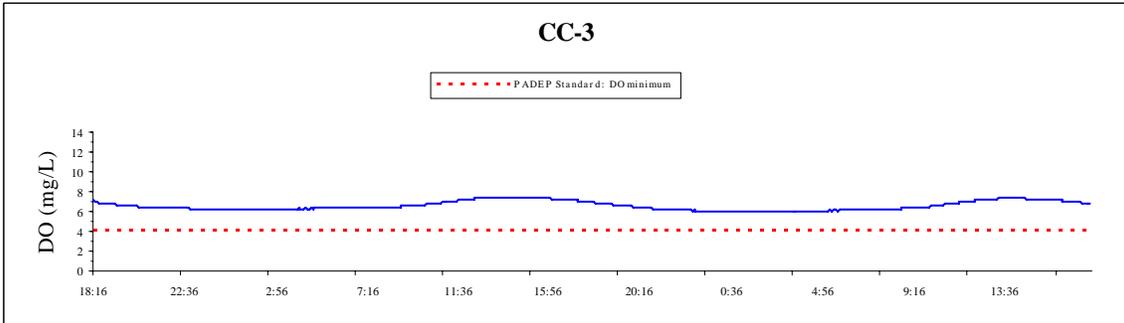
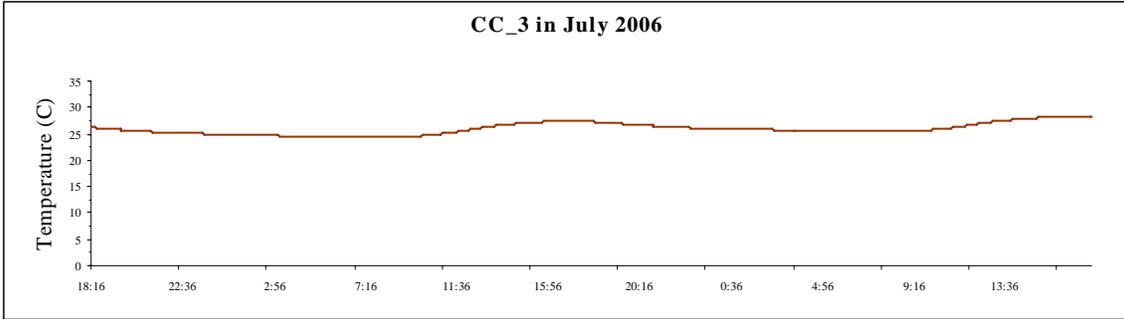


Table A-14: Discharger Water Quality Measurements in May 2006

Name of Discharger	Permit Number	Flow Ave./Max. (MGD)	Temp. (C)	CBOD5 (mg/L)	CBOD20 (mg/L)	TSS (mg/L)	TDS (mg/L)	Org. N (mg/L)
Concord Township Sewer Authority	PA0055212	0.753	17.6	8.8	20.1	7	622	0.1
Wawa, Inc.	PA0058769	0.0024	NA	7.8	NA	8.0J	338	ND
SW Delaware County Municipal Authority DMR	PA0027383	4.134	19	4	12	13	642	1.58
Cheyney University of PA	PA0030970	0.041	19.2	5	11	14	446	0.5
Stone Mill Estates LP/Riviera at Concord	PA 0054780	0.019	19.2	3.9	22.4	14	846	0.1
Westlake Plastics Company	PA0051438	0.2	13.9	<2.0	<2.0	4.8	257	<0.3
WESTTOWN SCHOOL	PA0050652	0.0162		7	10	20	864	0.6
GOOSE CREEK WWTP	PA0027031	0.703	35 DEG F	3.6	9.4	12.3	589	3.03
COTT BEVERAGE	PA0050431	0.0482/0.0594	20	2.5	2	12.7	1100	1.76
Westtown Chester Creek STP	PA0031771	0.1657	17.3	<2	<2	<2	561	0.5
Brinton Manor Inc.	PA0044474	0.0027	17.6	<2	<2.0	<2	716	1.6
Brookhaven Boro Delaware Cnty	PA0023949	0.1342	22.1	<6	>6.8	7	386	1.8
Concord Country Club	PA0031666	0.005	25.9	5	>6.2	4	378	6.1
Amer Comm Mgmt Svc/Concord Ind. Park	PA0032301	0.0086	14.6	4	>6.9	<2	727	<1.0
Pantos Corp/Coventry Crossing	PA0052434	0.0125	19	3	6.2	4	361	1.4
Garnet Valley Sch Dist	PA0031208	0.00431	13.6	5	>8.0	9	921	<1.0
Southco Inc	PA0051161	0.0042	15.7	3	>7.1	4	1150	1.1
Springhill Farm Wwtp Assn	PA0052230	0.052	20.3	<2	3.9	4	387	2.1
Valleybrook Homeowners Assoc Npdes	PA0040576	0.0287	18.2	6	>7.0	7	526	1.6
Walnut Hill Utility Co	PA0050237	0.02028	17.4	<2	2.5	4	440	<1.0
Malvern School at Glen Mills	PA0056821	0.007392	13.4	<2	2.2	8	593	2
Glen Mills School STP	PA0031747	0.0643	16.7	<2	5	<2	498	0.8
State Farm Mutual Auto Ins Co	PA0051756	0.014238	24.7	<2	<2.0	<2	682	<1.0
Thornbury Twp Delaware Cnty	PA0053473	0.113	17.4	4	>7.5	4	545	1.6
Laurel Pipe Line Company, L.P.	PA0012467	0.0247	9.43	<3.1		41.2	52	<1.0
West Goshen Township Sewer Authority	PA0028584	4.741	17.1	1.2	2.2	3	464	1.2
Sleighton School WWTF	PA0029980		13.9	1	2	154	5	
Fox Valley Community Services, Inc.	PA0030431	0.087	22.2	2	5	26	417	0.2

Table A-15: Discharger Water Quality Measurements in May 2006

Name of Discharger	Permit Number	NH3-N (mg/L)	NO2-N (mg/L)	NO3-N (mg/L)	TKN (mg/L)	TN (mg/L)	T. Diss. P (mg/L)	Ortho P (mg/L)
Concord Township Sewer Authority	PA0055212	0.1	0.04	44.4		44.54	0.35	0.25
Wawa, Inc.	PA0058769	4.2	0.061	1.6		1.2	0.25	0.025
SW Delaware County Municipal Authority DMR	PA0027383	2.21	0.025	26.6	3.79	30.4	0.52	0.55
Cheyney University of PA	PA0030970	1.6	0.125	15		2.1	2.2	2.3
Stone Mill Estates LP/Riviera at Concord	PA 0054780	0.1	0.48	40.1		40.74	2.39	2.15
Westlake Plastics Company	PA0051438	0.08	0.01	3.66		3.98	0.052	0.017
WESTTOWN SCHOOL	PA0050652	3.8	0.125	45		4.4	8.9	8.9
GOOSE CREEK WWTP	PA0027031	0.47	0.098	11.8		15.3	3.92	3.75
COTT BEVERAGE	PA0050431	0.11	0.02	2.16		4.03	0.077	0.016
Westtown Chester Creek STP	PA0031771	<0.5	0.1	27.8		29	3.9	3.96
Brinton Manor Inc.	PA0044474	0.6	0.1	3.34		5.54	8.54	8.77
Brookhaven Boro Delaware Cnty	PA0023949	2.5	0.58	19.6		24.48	3.08	3.16
Concord Country Club	PA0031666	10.1	2.34	0.66		19.2	2.31	2.23
Amer Comm Mgmt Svc/Concord Ind. Park	PA0032301	<0.5	0.1	57.7		57.7	4.69	4.47
Pantos Corp/Coventry Crossing	PA0052434	<0.5	0.1	16		17.4	4.59	4.89
Garnet Valley Sch Dist	PA0031208	1.5	0.36	88.6		88.96	10.6	9.84
Southco Inc	PA0051161	<0.5	0.1	109		110.1	8.44	15.9
Springhill Farm Wwtp Assn	PA0052230	<0.5	0.1	7.44		9.54	5.87	6.1
Valleybrook Homeowners Assoc Npdes	PA0040576	<0.5	0.1	36.2		37.8	5.41	5.68
Walnut Hill Utility Co	PA0050237	<0.5	0.1	29.6		29.6	4.26	4.08
Malvern School at Glen Mills	PA0056821	<0.5	0.1	9.9		11.9	1.93	2.17
Glen Mills School STP	PA0031747	2.4	0.34	30.6		34.14	6.47	6.2
State Farm Mutual Auto Ins Co	PA0051756	5.8	0.44	30.8		35.94	7.22	7.59
Thornbury Twp Delaware Cnty	PA0053473	1.6	0.42	30.8		34.42	5.7	5.91
Laurel Pipe Line Company, L.P.	PA0012467	0.43	0.019	0.39		0.852	<0.10	0.033
West Goshen Township Sewer Authority	PA0028584	0.72	0.24	17.9		19.6	1.7	1.6
Sleighton School WWTF	PA0029980	ND<0.2	0.125	1.3	ND<0.4		0.2	0.2
Fox Valley Community Services, Inc.	PA0030431	< 0.2	26	< 0.25		0.4	3.7	3.8

Table A-16: Discharger Water Quality Measurements in May 2006

Name of Discharger	Permit Number	Diss. Ortho P (mg/L)	TP (mg/L)	Conductivity (ymhos/cm)	Alkalinity (mg/L)	pH	DO (mg/L)
Concord Township Sewer Authority	PA0055212	0.18	0.43	1300	103.1	7.05	8.8
Wawa, Inc.	PA0058769	NA	0.28	656	135	6.6	4.65
SW Delaware County Municipal Authority DMR	PA0027383	0.54	0.63	1110	26	6.38	8.77
Cheyney University of PA	PA0030970	2.1	2.5	759	43	6.7	6.5
Stone Mill Estates LP/Riviera at Concord	PA 0054780	2.11	2.49	1300	241.9	7.42	6
Westlake Plastics Company	PA0051438	0.014	0.056	386	45.2	7.53	-
WESTTOWN SCHOOL	PA0050652	8.9	9	1700	233	7.7	3.5
GOOSE CREEK WWTP	PA0027031	3.74	4.77	878	160	7.37	9.71
COTT BEVERAGE	PA0050431	0.012	0.115	1600	164	7.7	8.8
Westtown Chester Creek STP	PA0031771	3.51	3.9	730	135	7.1	10.5
Brinton Manor Inc.	PA0044474	2.24	8.1	988	117	6.98	4.59
Brookhaven Boro Delaware Cnty	PA0023949	2.76	3.1	472	26	6.63	6.12
Concord Country Club	PA0031666	1.3	2.7	640	192	6.95	3.59
Amer Comm Mgmt Svc/Concord Ind. Park	PA0032301	4.69	4.4	834	43	7.09	8.84
Pantos Corp/Coventry Crossing	PA0052434	1.63	4.5	487	53	6.85	8.16
Garnet Valley Sch Dist	PA0031208	<0.02	8.6	1270	194	7.29	7.86
Southco Inc	PA0051161	3.64	9	1218	75	6.6	6.47
Springhill Farm Wwtp Assn	PA0052230	6.31	5.8	549	86	6.89	6.85
Valleybrook Homeowners Assoc Npdes	PA0040576	1.72	5.6	625	34	6.6	5.1
Walnut Hill Utility Co	PA0050237	4.26	4.2	582	61	6.76	7.21
Malvern School at Glen Mills	PA0056821	1.85	2.3	721	68	7.38	7.47
Glen Mills School STP	PA0031747	6.42	6.2	657	86	6.48	4.39
State Farm Mutual Auto Ins Co	PA0051756	6.98	7.2	917	211	7.13	4.56
Thornbury Twp Delaware Cnty	PA0053473	4.87	5.6	719	113	6.63	7.15
Laurel Pipe Line Company, L.P.	PA0012467	0.032	0.04	87	28.3	6.6	7.56
West Goshen Township Sewer Authority	PA0028584	1.4	1.925	654	51	6.54	8.5
Sleighton School WWTF	PA0029980	0.2	0.25	474	54	7.1	9.7
Fox Valley Community Services, Inc.	PA0030431	3.7	4.1	882	29	6.4	5.3

Table A-17: Discharger Water Quality Measurements in August 2006

Name of Discharger	Permit #	Flow Ave./Max. (MGD)	Temp. (C)	CBOD5 (mg/L)	CBOD20 (mg/L)	TSS (mg/L)	TDS (mg/L)	Org. N (mg/L)
Concord Township Sewer Authority	PA0055212	0.692	24.9	2	18.7	8.5	6.31	0.1
Wawa, Inc.	PA0058769	0.0024	20.3	<2.0	<2.0	11	350	<0.30
SW Delaware County Municipal Authority DMR	PA0027383	4.34	27	4	15	11	426	1.26
Cheyney University of PA	PA0030970	0.42	2.2	4	6	<5.0	318	<0.4
Stone Mill Estates LP/Riviera at Concord	PA 0054780	0.019	27.2	2	4.6	8	660	0.1
Westlake Plastics Company	PA0051438	0.0002	21.1	< 2.0	< 2.0	5	254	< 0.3
WESTTOWN SCHOOL	PA0050652	0.0183	29.6	4	5	6	639	0.4
GOOSE CREEK WWTP	PA0027031	0.866	39	ND	10	4.8	614	1.6
COTT BEVERAGE	PA0050431	46.6/63.7	28	2	2	3.3	1150	1
Westtown Chester Creek STP	PA0031771	0.235	25.7	<2	*	<2	496	0.5
Brinton Manor Inc.	PA0044474	0.006	26.8	2	3.2	3	848	0.83
Brookhaven Boro Delaware Cnty	PA0023949	0.136	27.1	<2	6.4	4	319	1.8
Concord Country Club	PA0031666	0.0071	33.5	8	>4.9	53	333	4.9
Amer Comm Mgmt Svc/Concord Ind. Park	PA0032301	0.005	27.9	<2	ND	<2	750	<1.0
Pantos Corp/Coventry Crossing	PA0052434	0.017	26.6	5	>7.9	<2	305	12.2
Garnet Valley Sch Dist	PA0031208	0.002	26.4	<2	3.2	15	648	1.1
Southco Inc	PA0051161	0.01	27.5	2	6.2	<2	680	<1.0
Springhill Farm Wwtp Assn	PA0052230	0.052	28.3	<2	2.9	<2	417	1.5
Valleybrook Homeowners Assoc Npdes	PA0040576	0.005	26.6	<2	ND	<2	750	<1.0
Walnut Hill Utility Co	PA0050237	0.029	25.9	4	>8.0	<2	433	1.8
Malvern School at Glen Mills	PA0056821	0.0056	24.3	2	6.8	12	669	0.5
Glen Mills School STP	PA0031747	0.073	28.2	3	ND	2	393	1.8
State Farm Mutual Auto Ins Co	PA0051756	0.0189	26.7	<2	ND	<2	747	<1.0
Thornbury Twp Delaware Cnty	PA0053473	0.132	25.8	2	>5.3	3	558	<1.0
Laurel Pipe Line Company, L.P.	PA0012467	0.0254	16.66	< 3.9	2.17	10	71	< 1.0
West Goshen Township Sewer Authority	PA0028584	4.6	22.8	1.1	2.1	5	456	<1.0
Sleighton School WWTF	PA0029980			3	4	<5	138	<0.4
Fox Valley Community Services, Inc.	PA0030431	0.0648	21.5	3	5	7	382	0.4

Table A-18: Discharger Water Quality Measurements in August 2006

Name of Discharger	Permit #	NH3-N (mg/L)	NO2-N (mg/L)	NO3-N (mg/L)	TKN (mg/L)	TN (mg/L)	T. Diss. P (mg/L)	Ortho P (mg/L)
Concord Township Sewer Authority	PA0055212	0.1	0.07	39.4		39.57	0.58	0.32
Wawa, Inc.	PA0058769	0.81	<0.010	2.5		3.3	0.19	0.16
SW Delaware County Municipal Authority DMR	PA0027383	1.26	<0.05	13.9		15.9	2.66	2.38
Cheyney University of PA	PA0030970	<0.4	<0.25	6.8		<0.2	1.1	1.2
Stone Mill Estates LP/Riviera at Concord	PA 0054780	0.1	0.36	40.4		40.86	2.52	1.77
Westlake Plastics Company	PA0051438	0.06	< 0.020	5.38		5.47	0.202	0.208
WESTTOWN SCHOOL	PA0050652	1.6	0.25	37		2	7.4	7.3
GOOSE CREEK WWTP	PA0027031	0.1	ND	1.62		3.23	3.33	3.36
COTT BEVERAGE	PA0050431	0.56	0.02	1.56		1.56	0.061	0.05
Westtown Chester Creek STP	PA0031771	<0.5	0.26	21.8		23	3.13	3.48
Brinton Manor Inc.	PA0044474	0.57	ND	1.02		2.42	6.28	6.09
Brookhaven Boro Delaware Cnty	PA0023949	<0.5	ND	21.2		23	2.6	2.67
Concord Country Club	PA0031666	<0.5	0.22	2.34		7.46	5.58	5.77
Amer Comm Mgmt Svc/Concord Ind. Park	PA0032301	<0.5	ND	65.6		65.6	5.72	4.97
Pantos Corp/Coventry Crossing	PA0052434	<0.5	ND	2.64		14.84	3.89	3.82
Garnet Valley Sch Dist	PA0031208	<0.5	ND	42.5		43.6	4.76	1.96
Southco Inc	PA0051161	<0.5	ND	56.7		56.7	9.09	2.41
Springhill Farm Wwtp Assn	PA0052230	<0.5	ND	6.18		7.68	7.13	7
Valleybrook Homeowners Assoc Npdes	PA0040576	<0.5	ND	65.6		65.6	5.72	4.97
Walnut Hill Utility Co	PA0050237	<0.5	ND	27.1		28.9	3.94	4.18
Malvern School at Glen Mills	PA0056821	1.7	0.86	28.2		31.26	3.52	3.42
Glen Mills School STP	PA0031747	7.7	ND	1.04		10.54	3.12	2.36
State Farm Mutual Auto Ins Co	PA0051756	<0.5	ND	58.6		58.6	7.6	7.86
Thornbury Twp Delaware Cnty	PA0053473	<0.5	0.2	40		40.2	6.42	6.8
Laurel Pipe Line Company, L.P.	PA0012467	< 0.20	0.021	0.4		0.536	< 0.10	0.086
West Goshen Township Sewer Authority	PA0028584	1.3	0.56	21.6		24.1	1.8	2
Sleighton School WWTF	PA0029980	<0.2	<0.25	1.4	<0.4		0.3	0.3
Fox Valley Community Services, Inc.	PA0030431	0.2	24	0.25		0.4	3	3

Table A-19: Discharger Water Quality Measurements in August 2006

Name of Discharger	Permit #	Diss. Ortho P (mg/L)	Org. P (mg/L)	TP (mg/L)	Conduct. (ymhos/cm)	Alkalinity (mg/L)	pH	DO (mg/L)	TOC (mg/L)
Concord Township Sewer Authority	PA0055212	0.28	0.3	0.62	800	260.5	7.11	7.1	7.1
Wawa, Inc.	PA0058769	0.16	0.06	0.22	625	140	7.3	0.89	
SW Delaware County Municipal Authority DMR	PA0027383	2.35	0.09	2.47	731	45	6.48	4.69	8.5
Cheyney University of PA	PA0030970	1.1	0.1	1.3	843	57	7	9.5	6.1
Stone Mill Estates LP/Riviera at Concord	PA 0054780	1.77	1.05	2.82	1100	177.6	7.86	5.1	9
Westlake Plastics Company	PA0051438	0.202	0.029	0.237	399	52.8	7.5	8.54	
WESTTOWN SCHOOL	PA0050652	7.4	0.3	7.6	1346	88	7.5	4.5	6.6
GOOSE CREEK WWTP	PA0027031	3.33	0.57	3.93	947	95.4	7.48	8.99	12.6
COTT BEVERAGE	PA0050431	0.05	0.046	0.096	1790	367	7.6	7.4	2.07
Westtown Chester Creek STP	PA0031771	3.42	0	3.43	681	152	7.1	7.8	4.3
Brinton Manor Inc.	PA0044474	6.02	0.26	6.35	1161	181	7.27	4.61	5.8
Brookhaven Boro Delaware Cnty	PA0023949	2.62	0.29	2.96	418	22	6.14	5.49	6.6
Concord Country Club	PA0031666	5.64	0.95	6.72	504	56	6.4	7.99	7.1
Amer Comm Mgmt Svc/Concord Ind. Park	PA0032301	5.46	0.87	5.84	865	46	6.65	4.7	7.2
Pantos Corp/Coventry Crossing	PA0052434	3.82	0.22	4.04	489	118	7.36	7.06	10.7
Garnet Valley Sch Dist	PA0031208	1.95	3.21	5.17	816	219	6.74	7.74	8.6
Southco Inc	PA0051161	2.19	6.88	9.29	840	84	7.14	5.75	9.4
Springhill Farm Wwtp Assn	PA0052230	6.88	0.06	7.06	6.5	108	6.91	7.45	6.3
Valleybrook Homeowners Assoc Npdes	PA0040576	5.46	0.87	5.84	865	46	6.65	4.7	7.2
Walnut Hill Utility Co	PA0050237	3.92	0	4.18	536	44	6.63	6.04	9.2
Malvern School at Glen Mills	PA0056821	3.35	0.45	3.87	747	39	6.91	8.28	6.1
Glen Mills School STP	PA0031747	2.27	3.79	6.15	596	193	6.83	4.22	10.5
State Farm Mutual Auto Ins Co	PA0051756	7.8	0.35	8.21	864	75	7	5.39	8.5
Thornbury Twp Delaware Cnty	PA0053473	6.32	0	6.19	6.97	76	6.69	5.35	10
Laurel Pipe Line Company, L.P.	PA0012467	0.088	0	0.04	113	35.2	7.1	5.53	3.9
West Goshen Township Sewer Authority	PA0028584	1.7	0	1.8	653	54	6.4	7.3	6.4
Sleighton School WWTF	PA0029980	0.3	0	0.3	454	43	7.1	9.2	1.4
Fox Valley Community Services, Inc.	PA0030431	3	0.3	3.3	897	41	6.7	8	1

Appendix B. Discharge Monitoring Report Graphs and Violations

- Discharge Monitoring Report Graphs
- Permit Violations

Discharge Monitoring Report Graphs

Figure B.1: Twin Oaks Terminal IWSW 001 Flow Quantity

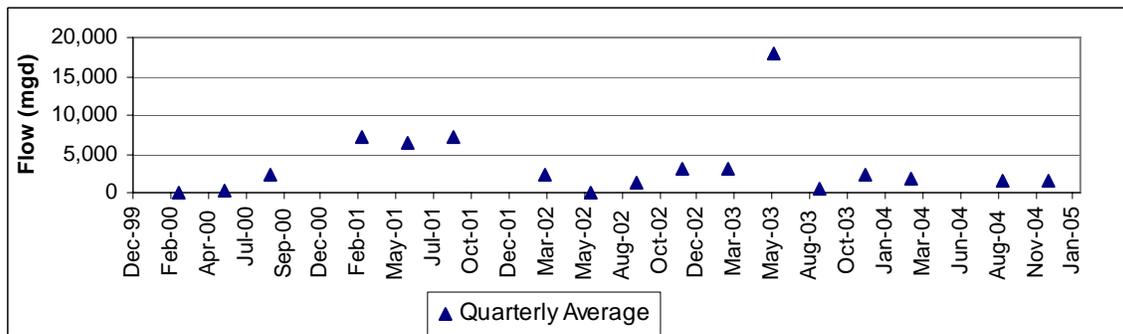


Figure B.2: Twin Oaks Terminal IWSW 001 GRO Concentration

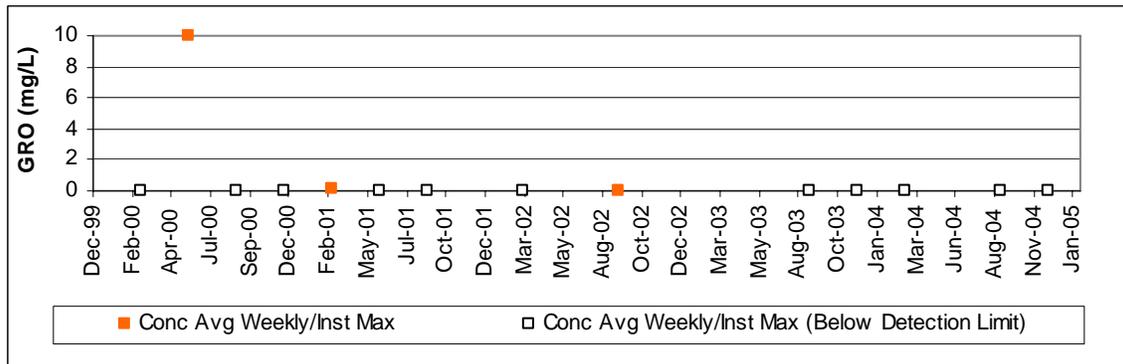


Figure B.3: Twin Oaks Terminal IWSW 001 TRPH Concentration

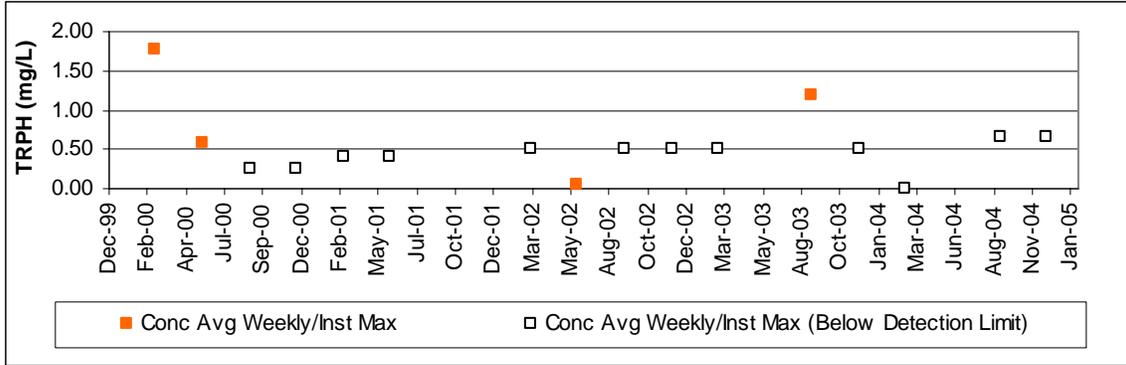


Figure B.4: Thornbury Township STP Flow Quantity

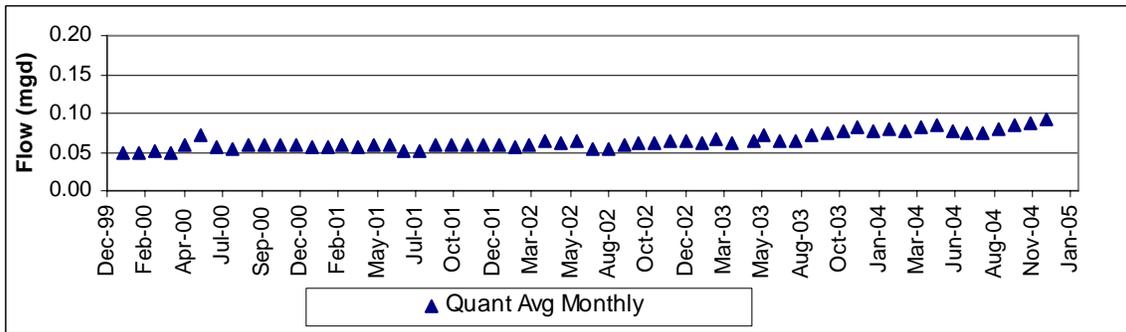


Figure B.5: Thornbury Township STP CBOD5 Quantity

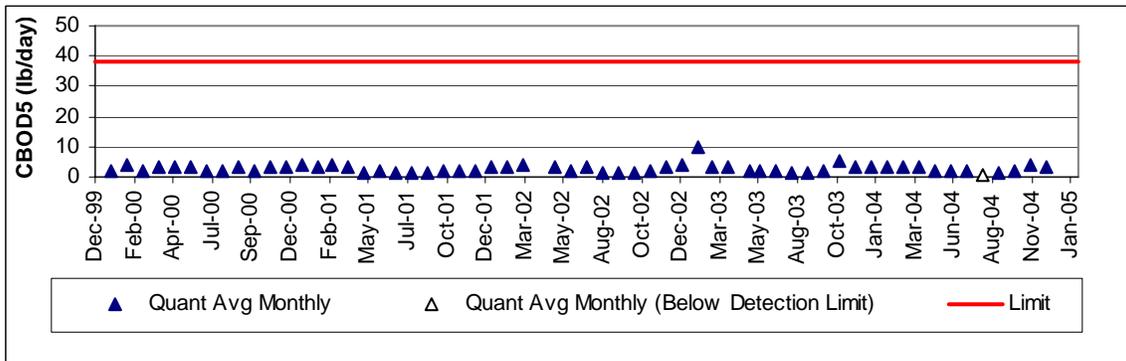


Figure B.6: Thornbury Township STP CBOD5 Concentration

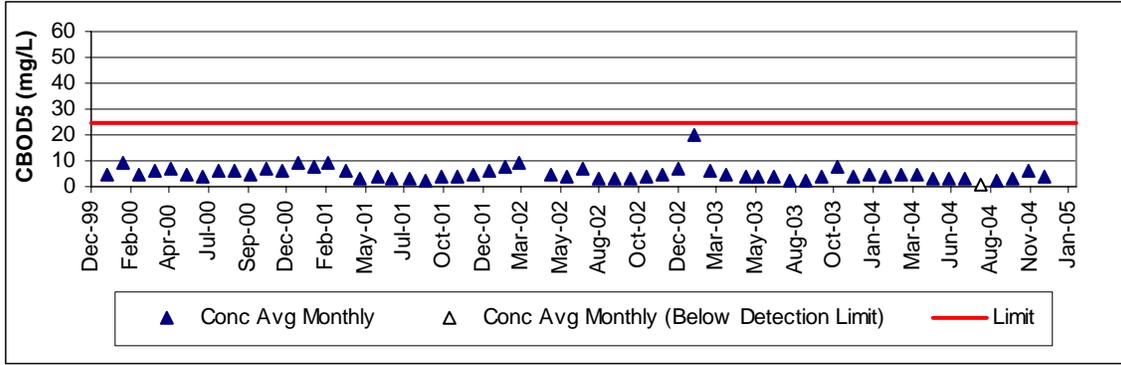


Figure B.7: Thornbury Township STP pH Concentration

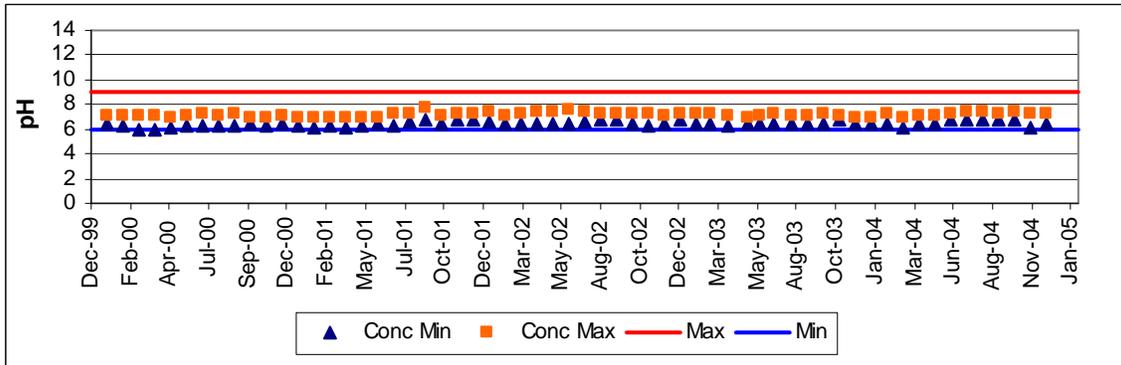


Figure B.8: Thornbury Township STP TSS Quantity

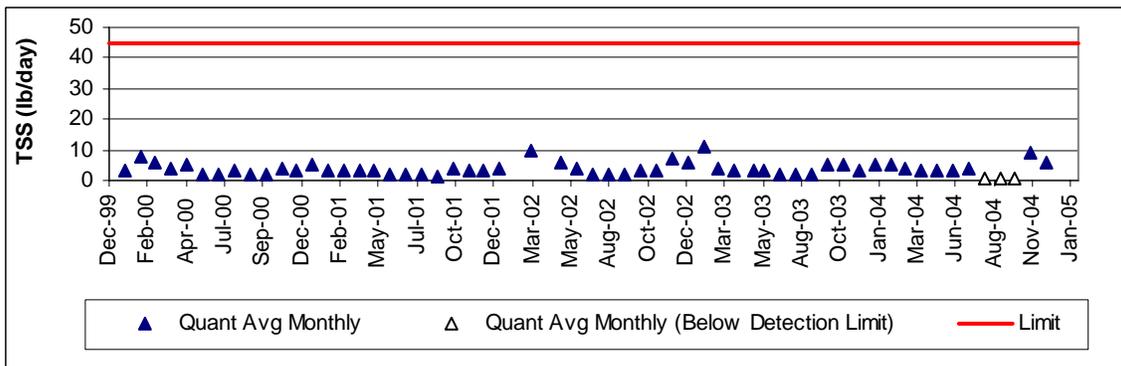


Figure B.9: Thornbury Township STP TSS Concentration

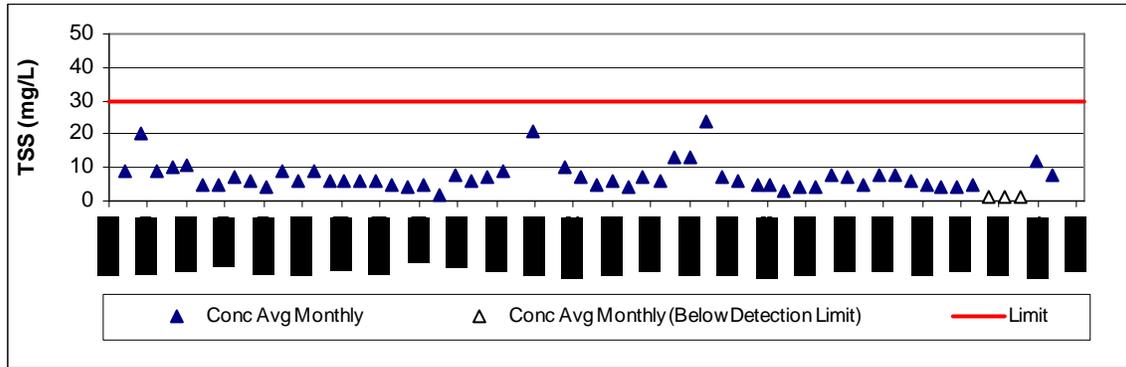


Figure B.10: Thornbury Township STP Dissolved Oxygen Concentration

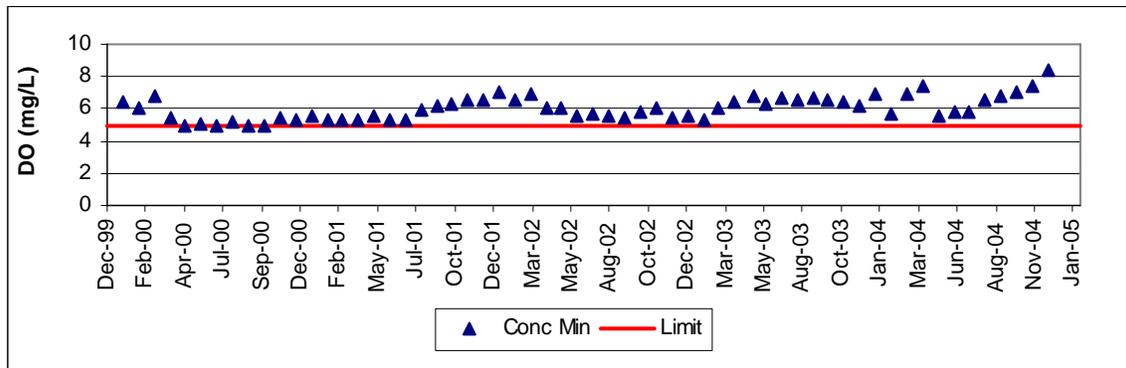


Figure B.11: Thornbury Township STP Ammonia Quantity

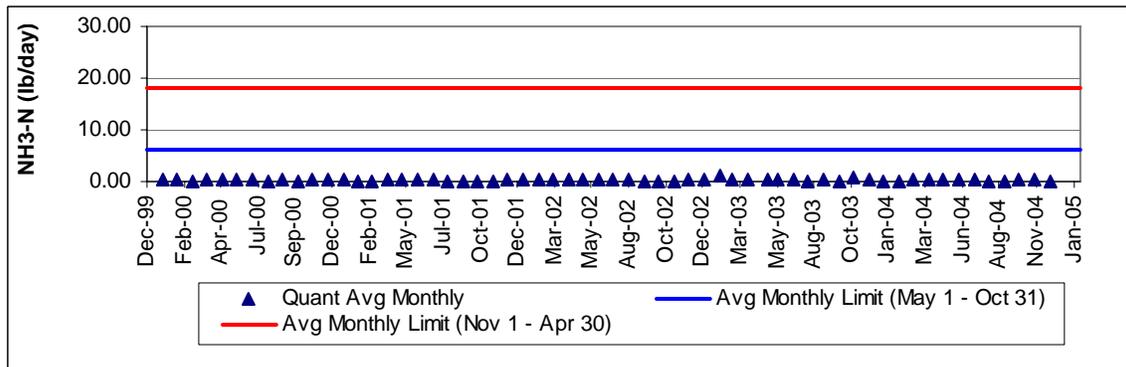


Figure B.12: Thornbury Township STP Ammonia Concentration

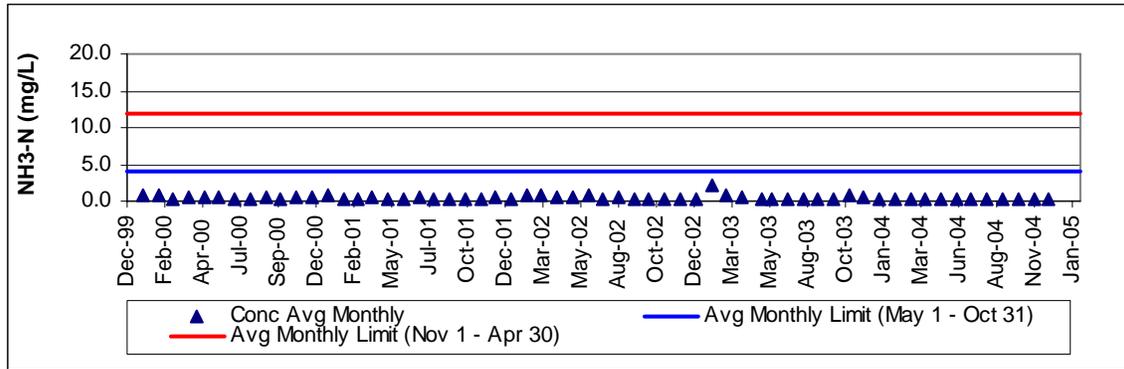


Figure B.13: Thornbury Township STP Fecal Coliform Concentration

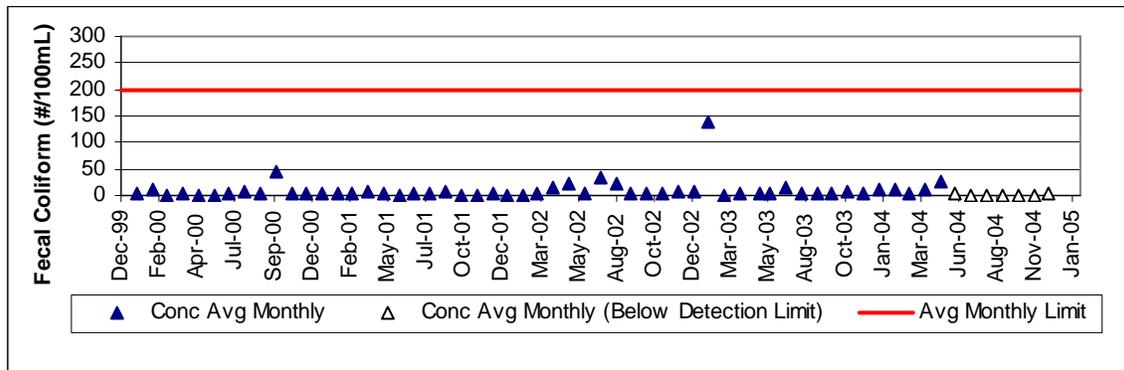


Figure B.14: Thornbury Township STP TRC Concentration

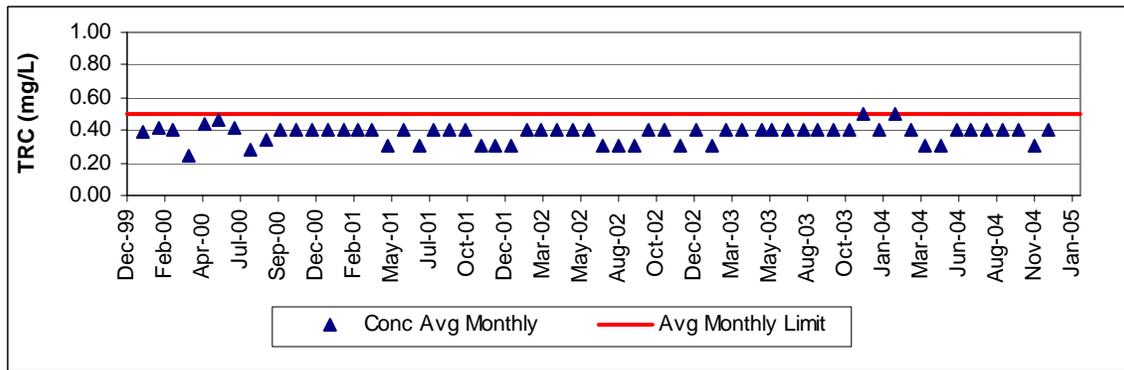


Figure B.15: Westlake Plastics IWTP Flow Quantity

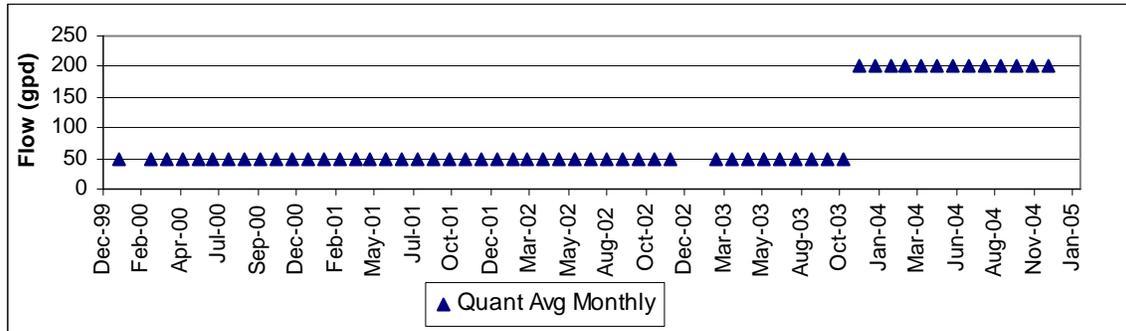


Figure B.16: Westlake Plastics IWTP Oil and Grease Concentration

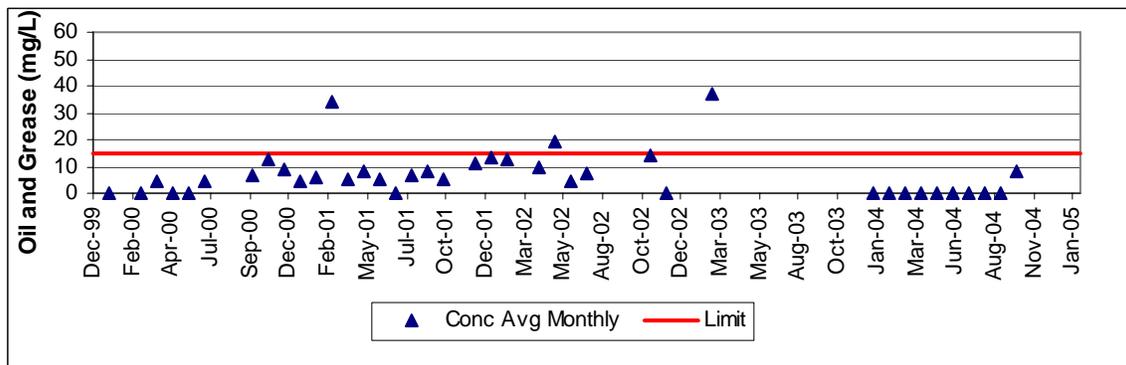


Figure B.17: Westlake Plastics IWTP Temperature Concentration

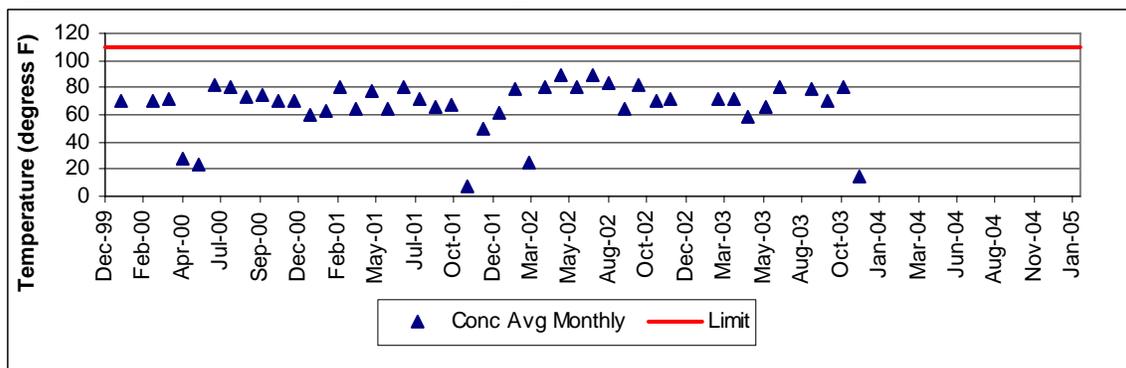


Figure B.18: Westlake Plastics IWTP pH Concentration

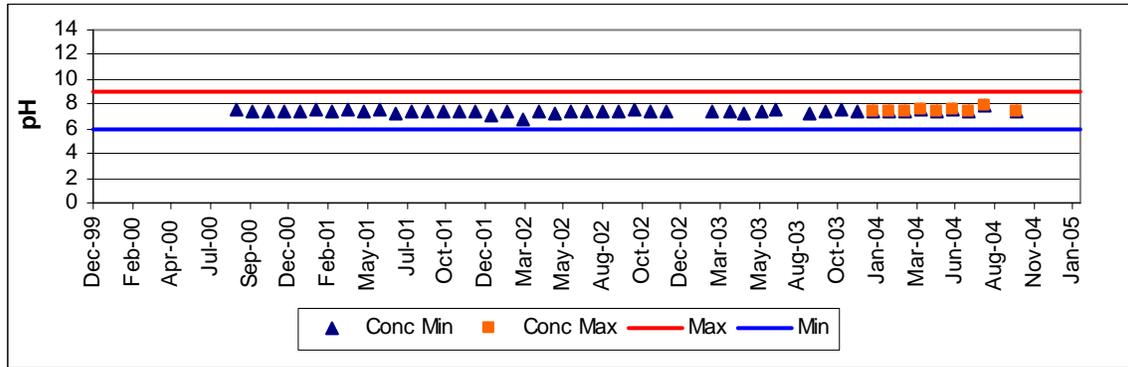


Figure B.19: Westlake Plastics IWTP TSS Concentration

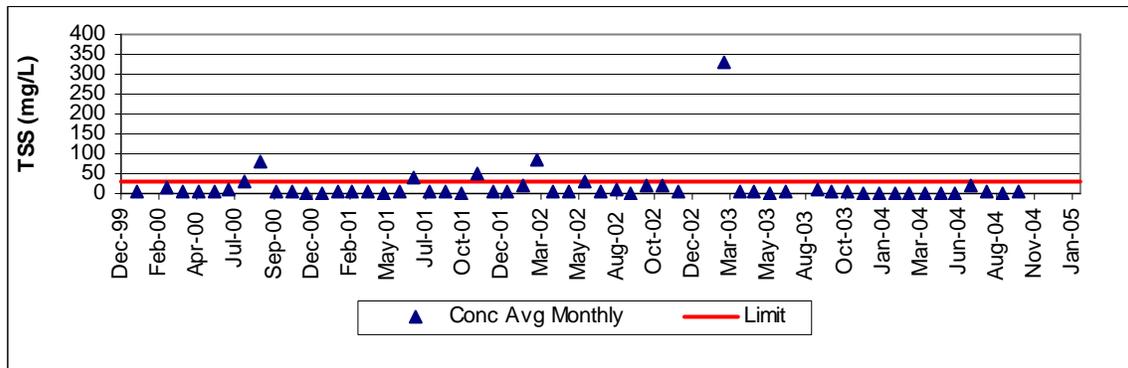


Figure B.20: Glen Mills School WWTP Flow Quantity

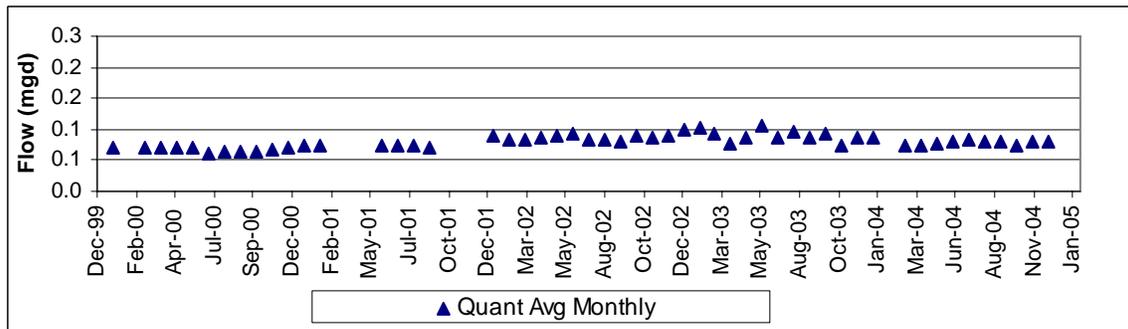


Figure B.21: Glen Mills School WWTP CBOD5 Concentration

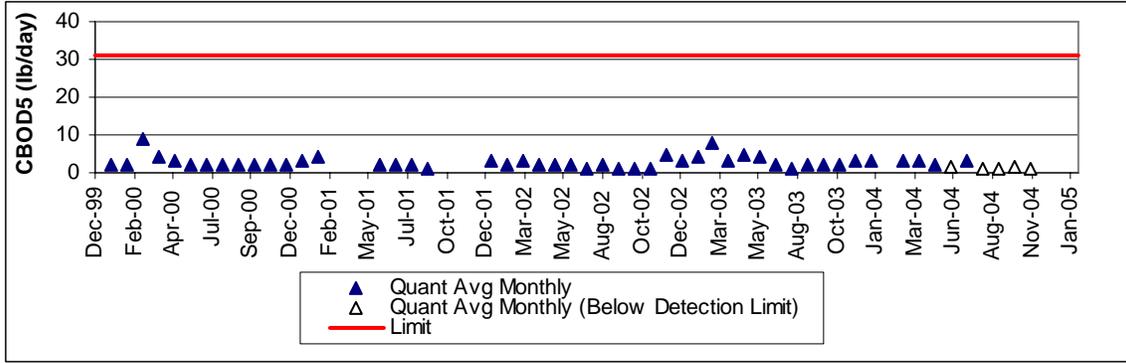


Figure B.22: Glen Mills School WWTP CBOD5 Quantity

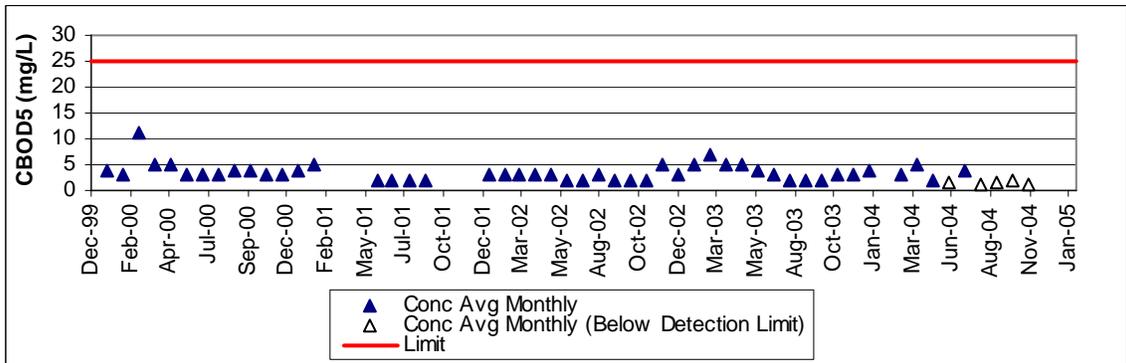


Figure B.23: Glen Mills School WWTP pH Concentration

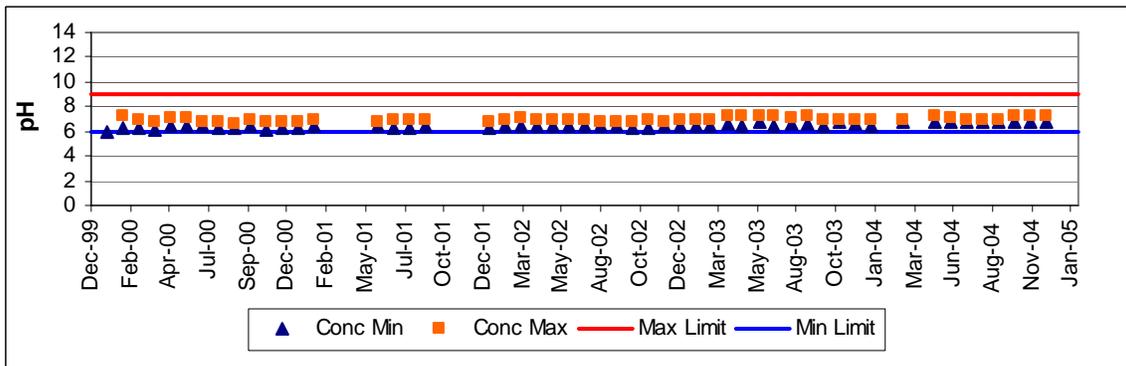


Figure B.24: Glen Mills School WWTP TSS Quantity

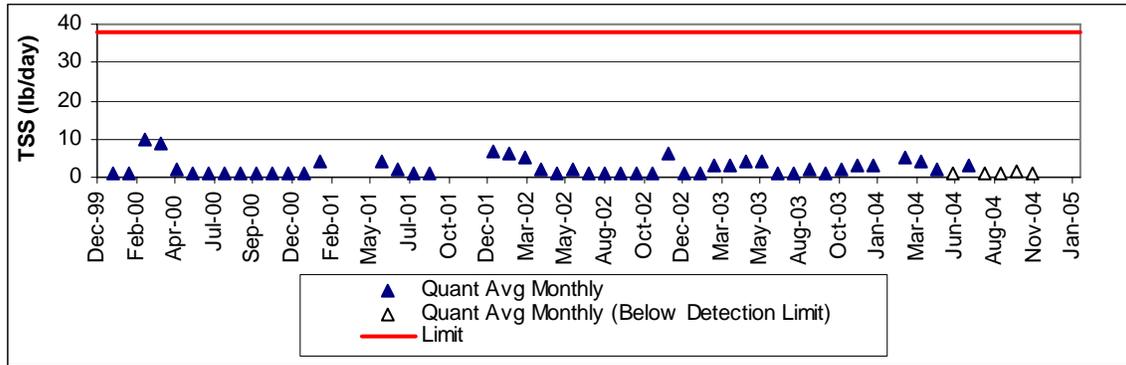


Figure B.25: Glen Mills School WWTP TSS Concentration

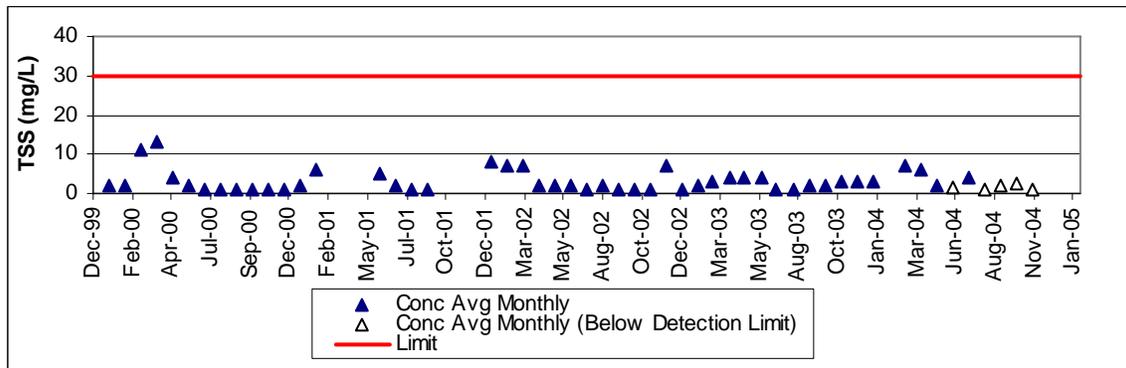


Figure B.26: Glen Mills School WWTP Dissolved Oxygen Concentration

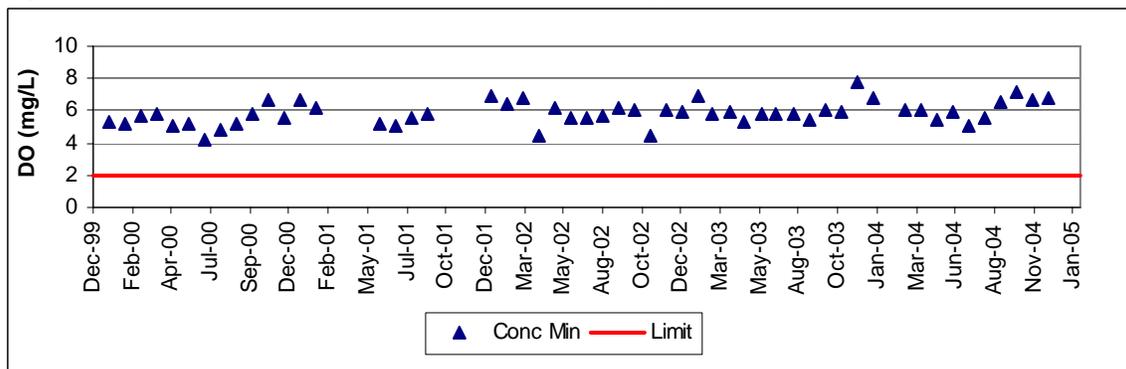


Figure B.27: Glen Mills School WWTP Fecal Coliform Concentration

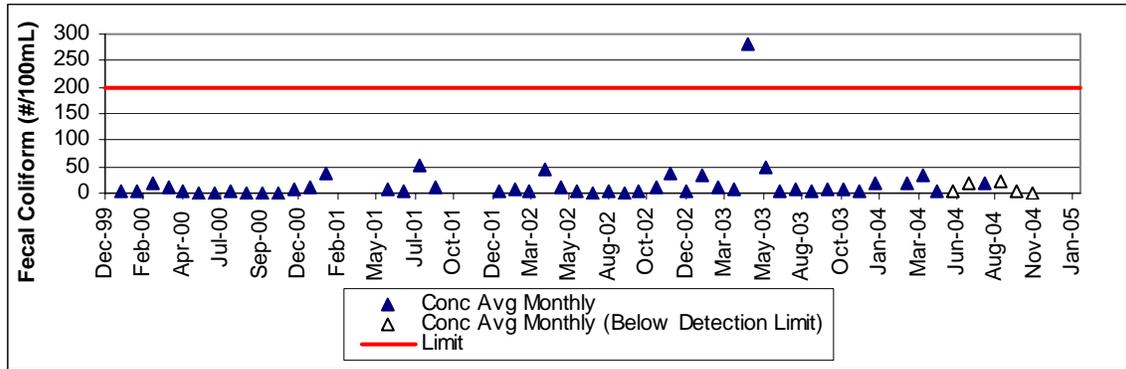


Figure B.28: Glen Mills School WWTP AMMONIA Quantity

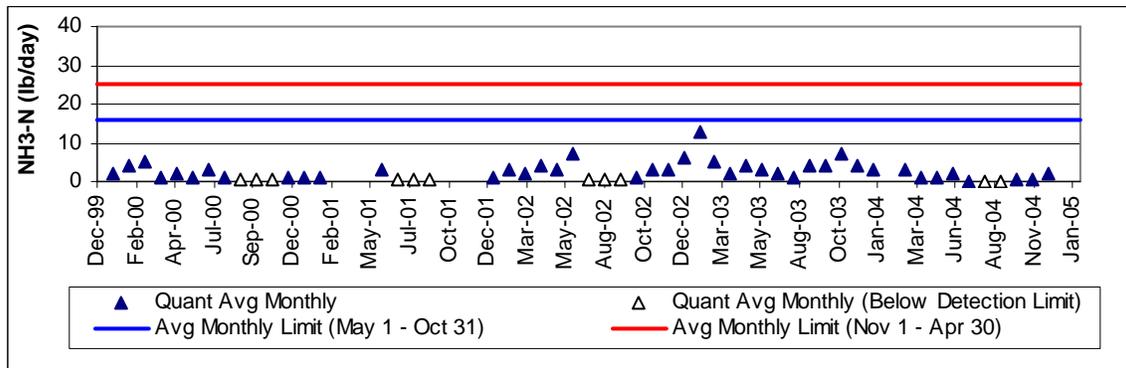


Figure B.29: Glen Mills School WWTP AMMONIA Concentration

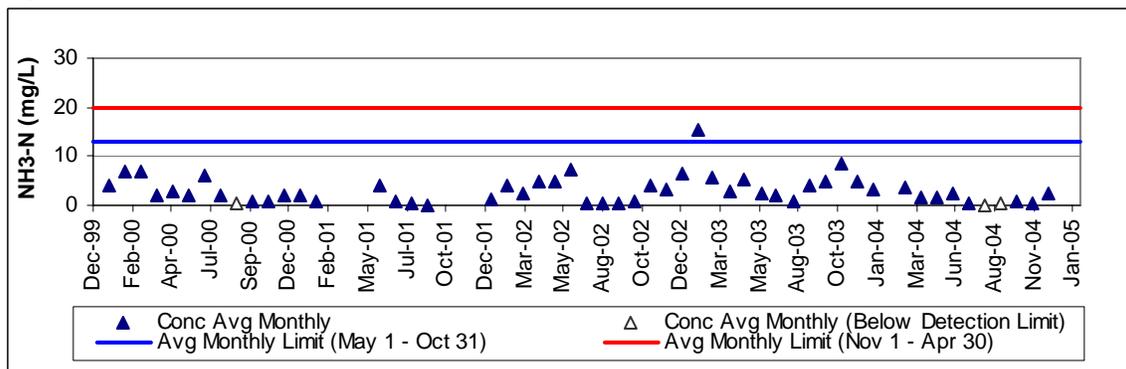


Figure B.30: Glen Mills School WWTP TRC Concentration

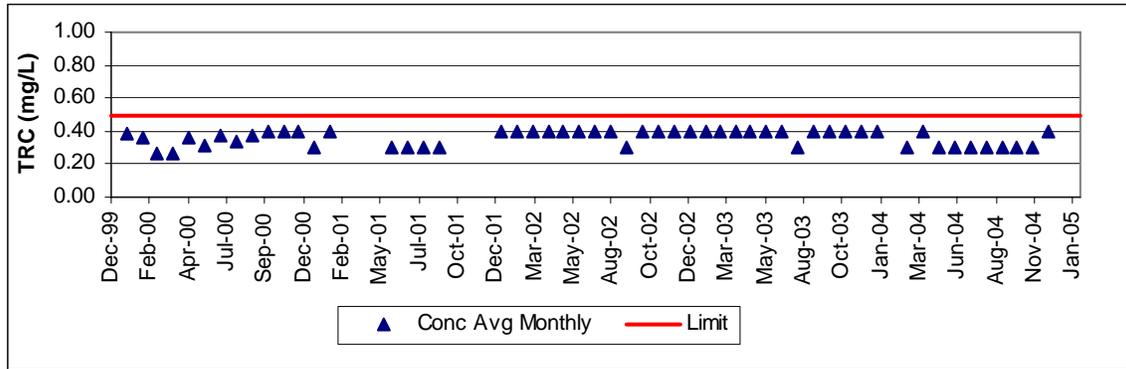


Figure B.31: Walnut Hill Utility Company Flow Quantity

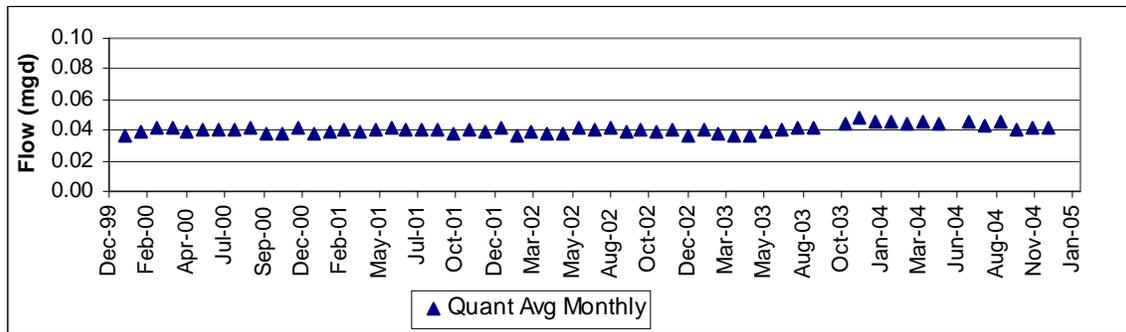


Figure B.32: Walnut Hill Utility Company CBOD5 Quantity

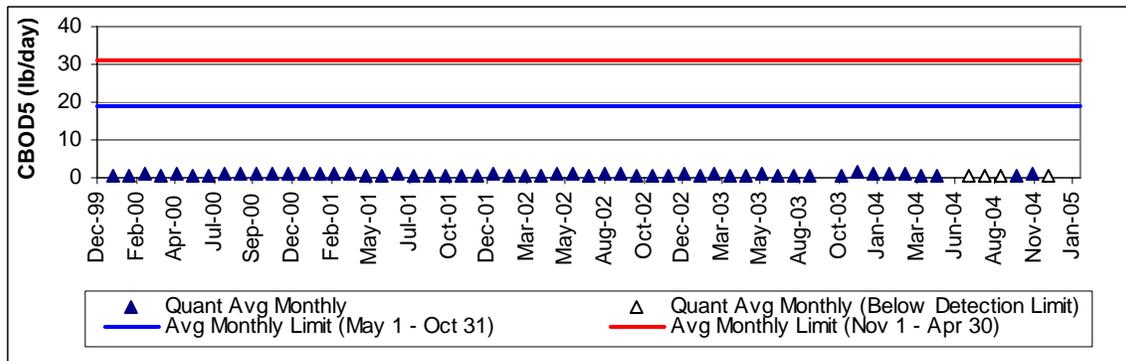


Figure B.33: Walnut Hill Utility Company CBOD5 Concentration

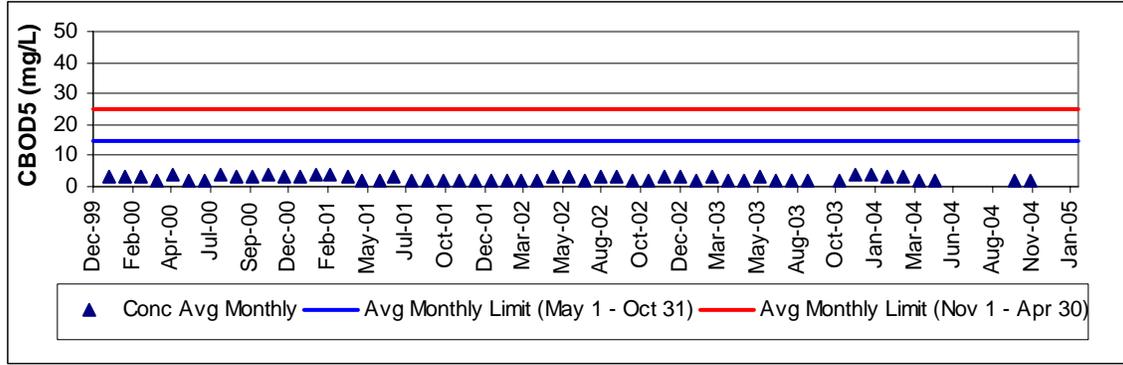


Figure B.34: Walnut Hill Utility Company pH Concentration

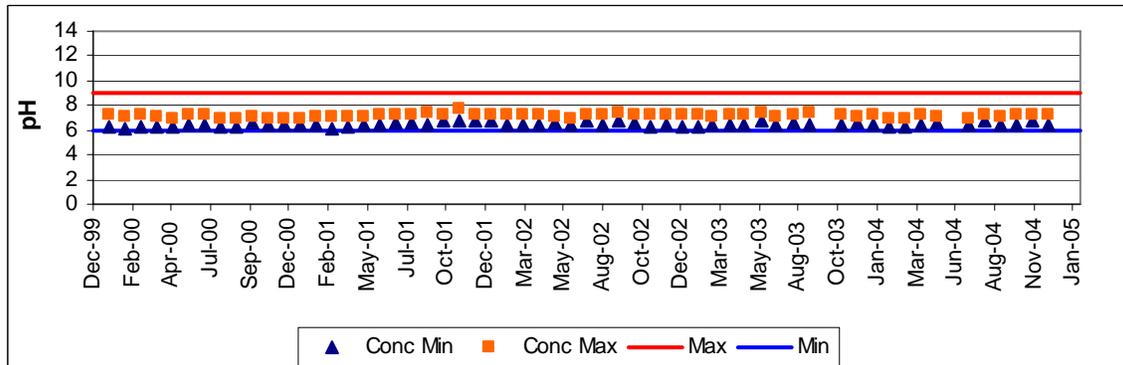


Figure B.35: Walnut Hill Utility Company TSS Quantity

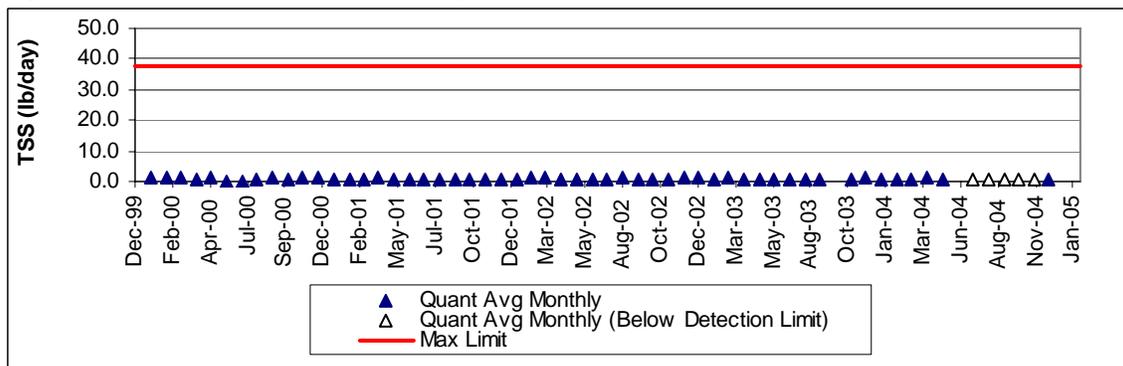


Figure B.36: Walnut Hill Utility Company TSS Concentration

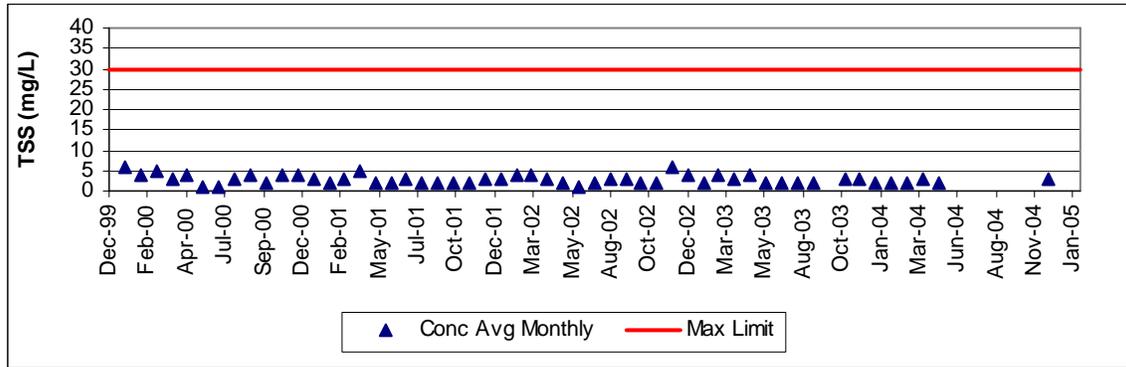


Figure B.37: Walnut Hill Utility Company Dissolved Oxygen Concentration

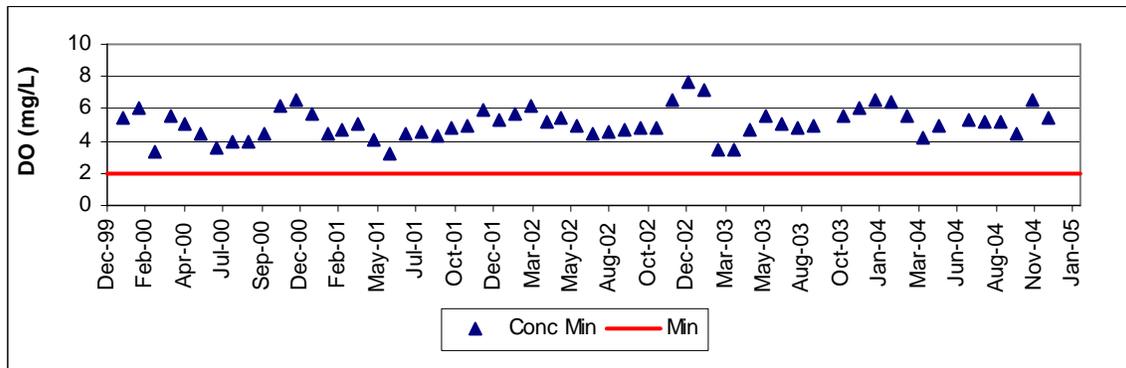


Figure B.38: Walnut Hill Utility Company Ammonia Quantity

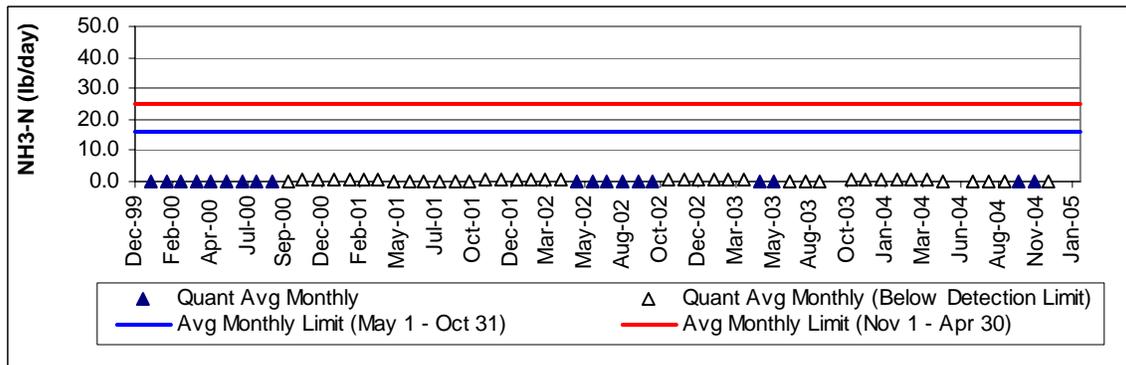


Figure B.39: Walnut Hill Utility Company Ammonia Concentration

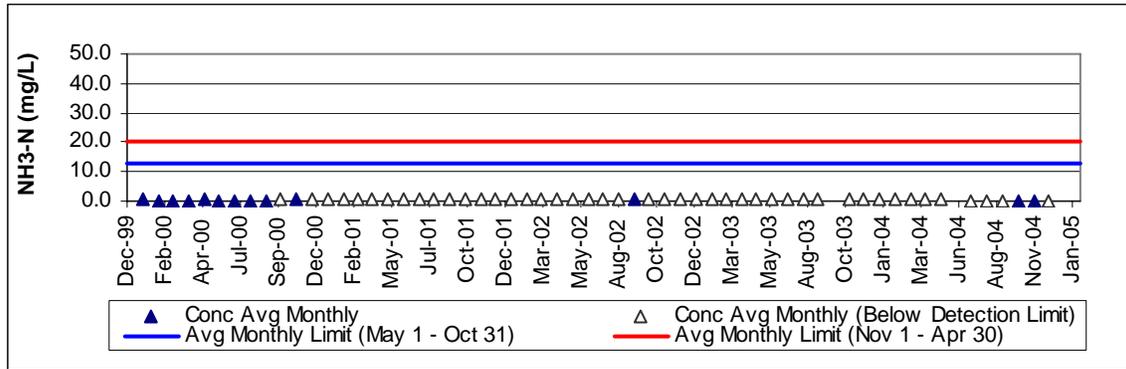


Figure B.40: Walnut Hill Utility Company Fecal Coliform Concentration

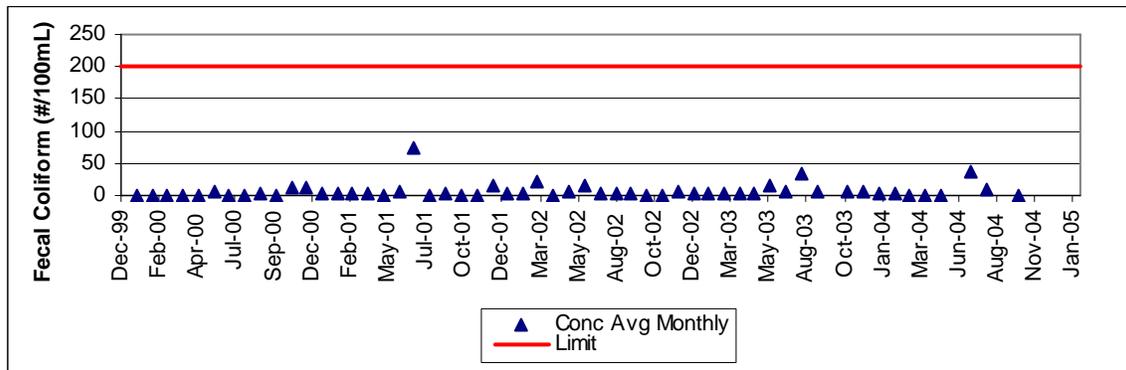


Figure B.41: Walnut Hill Utility Company TRC Concentration

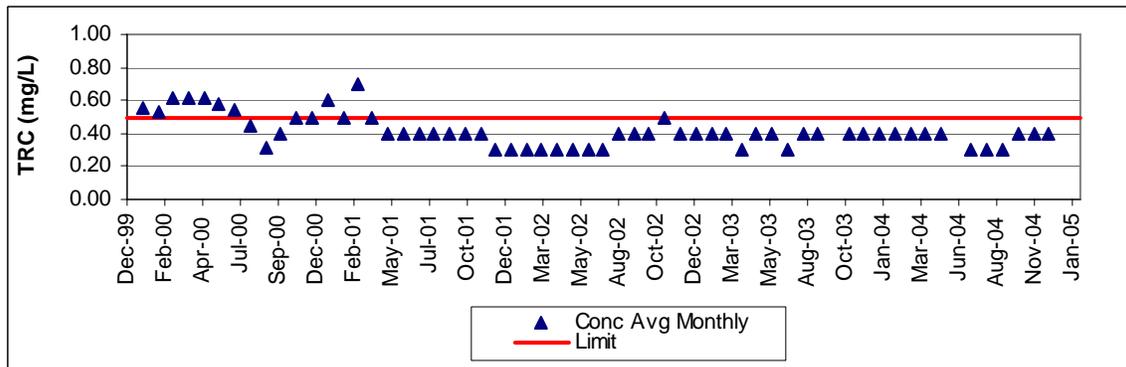


Figure B.42: Schramm, Inc Flow Quantity

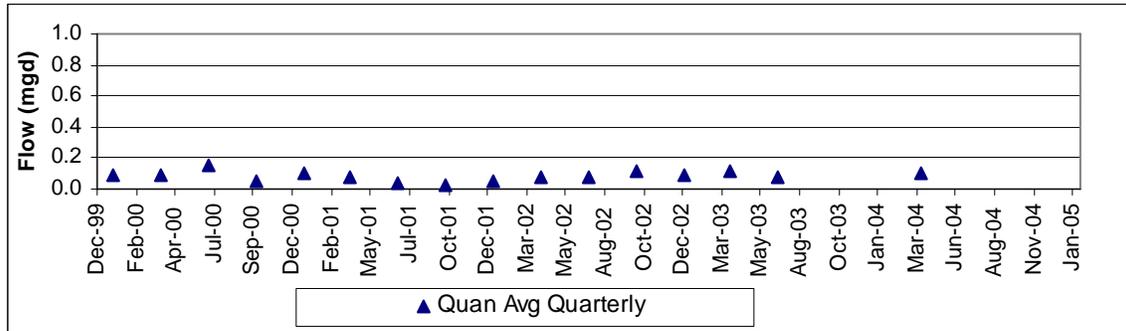


Figure B.43: Schramm, Inc pH Concentration

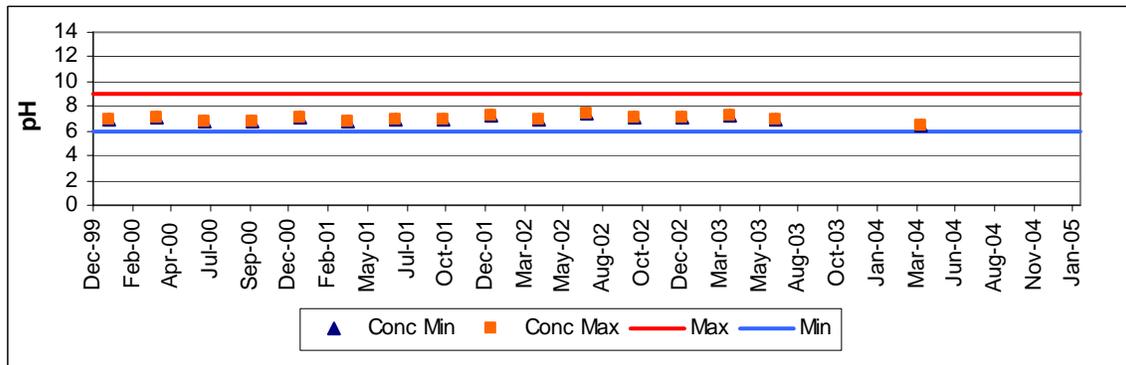


Figure B.44: Schramm, Inc CBOD5 Concentration

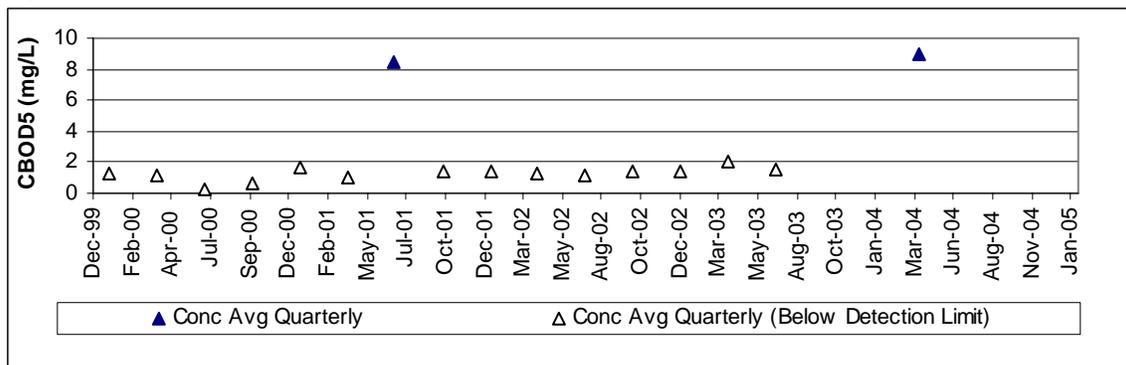


Figure B.45: Schramm, Inc COD Concentration

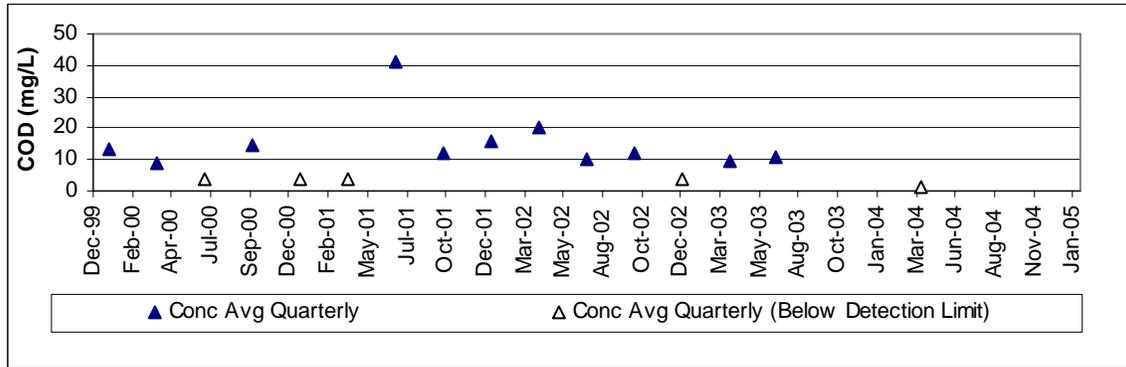


Figure B.46: Schramm, Inc Dissolved Iron Concentration

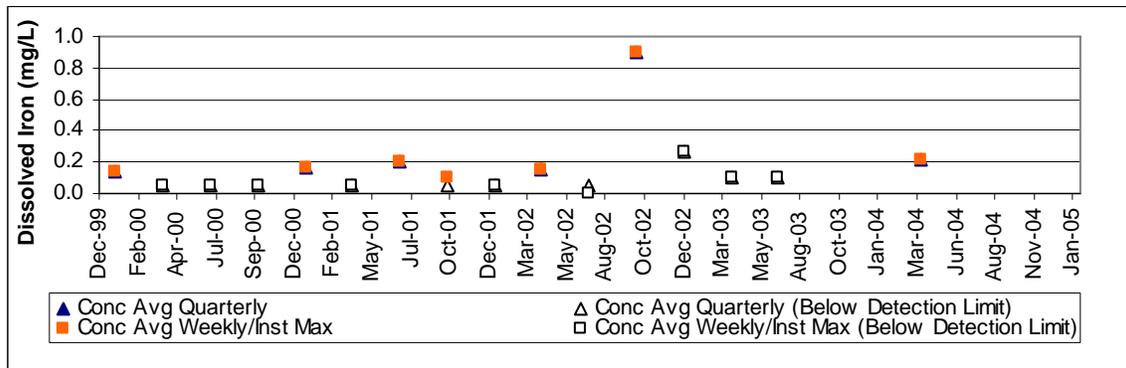


Figure B.47: Schramm, Inc Phosphorous Concentration

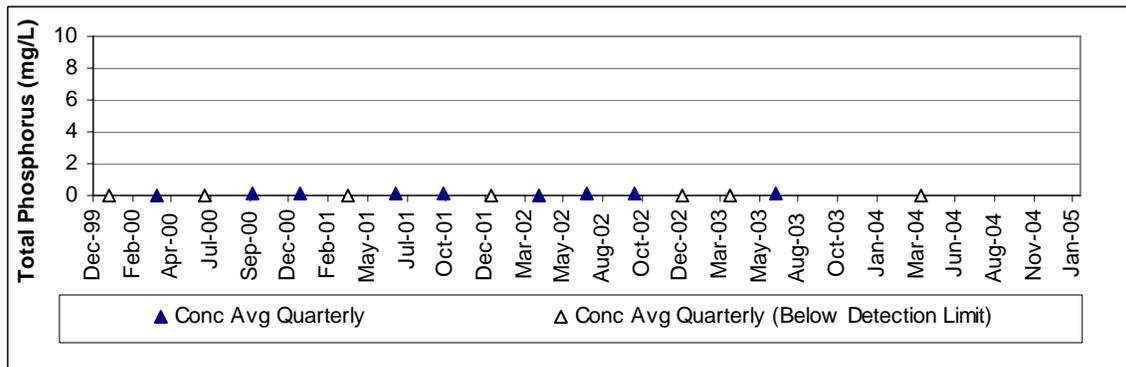


Figure B.48: Schramm, Inc Oil and Grease Concentration

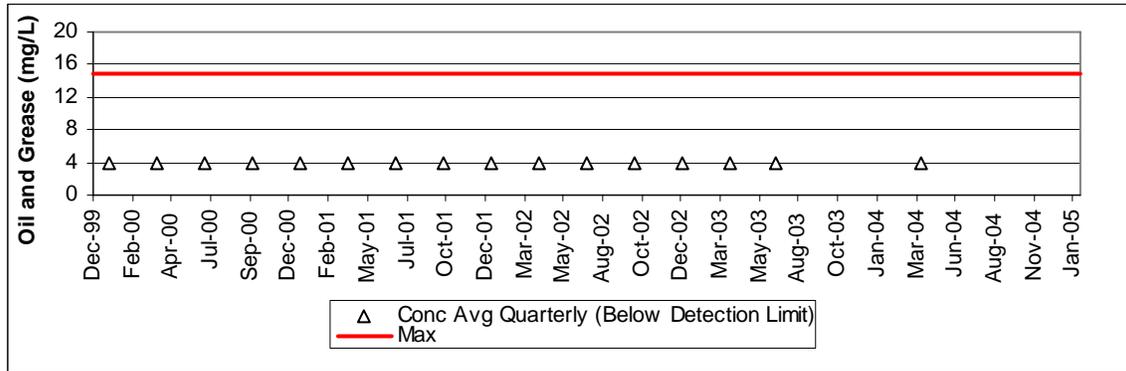


Figure B.49: Schramm, Inc TKN Concentration

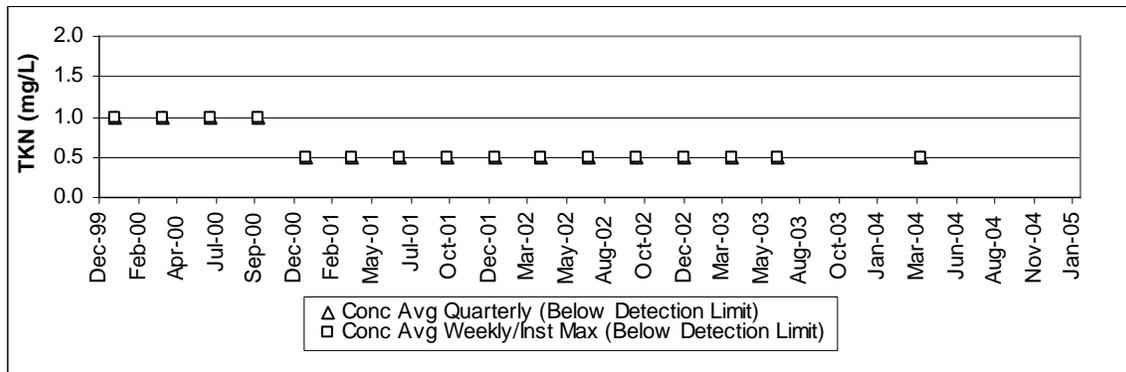


Figure B.50: Schramm, Inc TSS Concentration

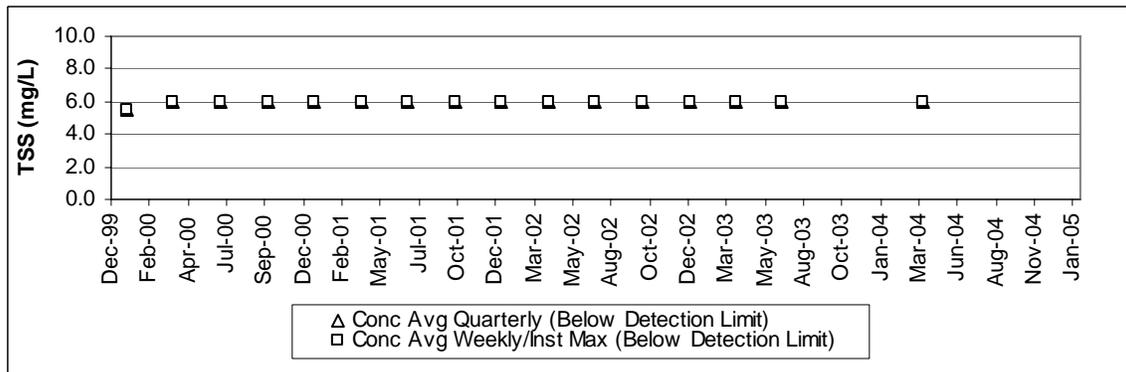


Figure B.51: Brinton Manor STP Flow

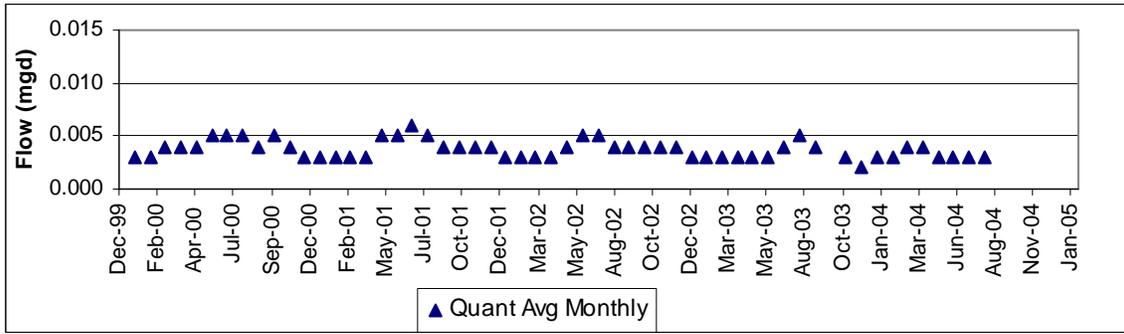


Figure B.52: Brinton Manor STP pH Concentration

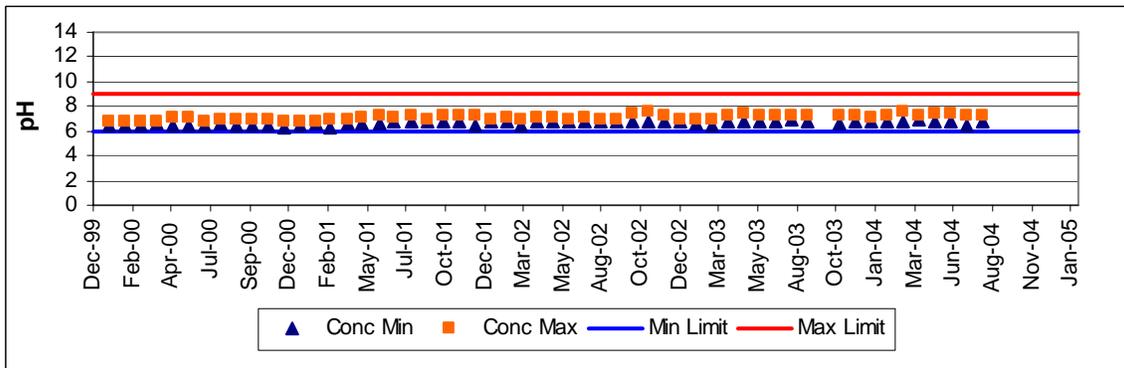


Figure B.53: Brinton Manor STP CBOD5 Concentration

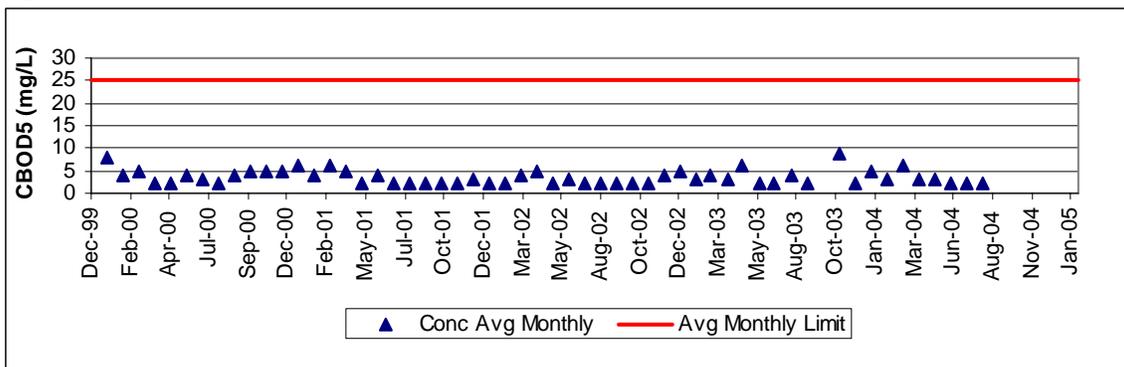


Figure B.54: Brinton Manor STP TSS Concentration

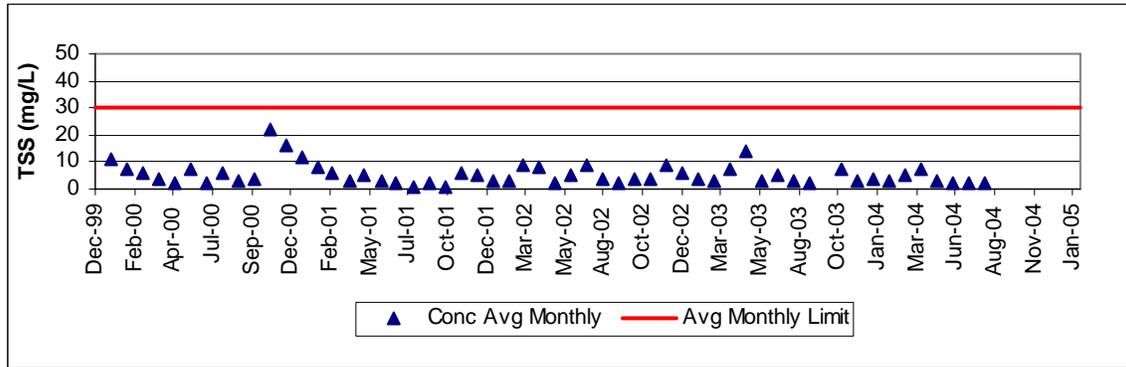


Figure B.55: Brinton Manor STP Dissolved Oxygen Concentration

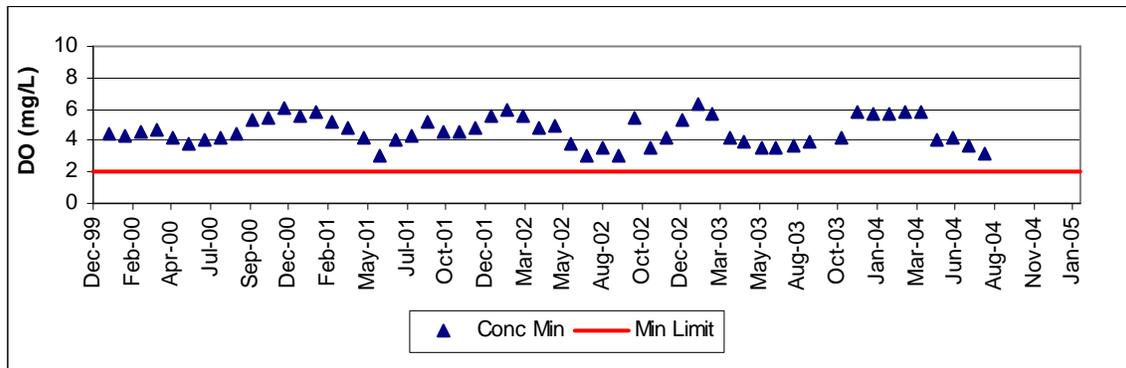


Figure B.56: Brinton Manor STP Ammonia Concentration

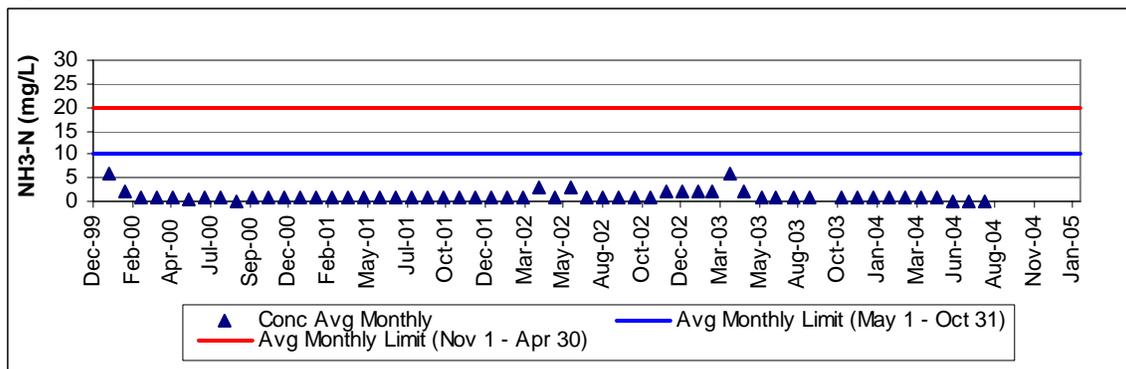


Figure B.57: Brinton Manor STP Fecal Coliform Concentration

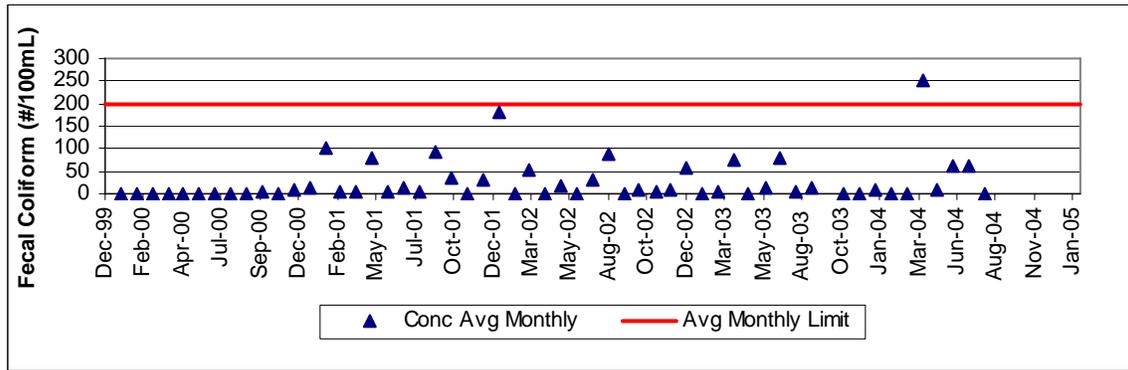


Figure B.58: Brinton Manor STP TRC Concentration

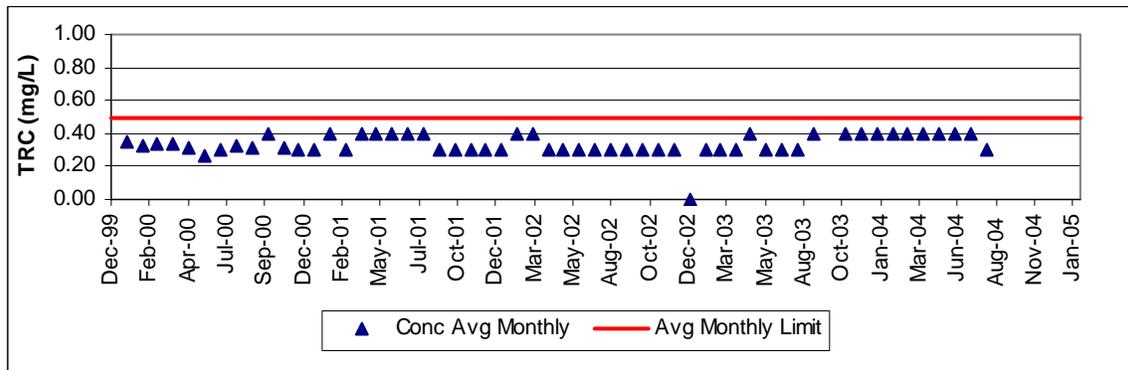


Figure B.59: Concord Beverage IWWTP MP001 Flow Quantity

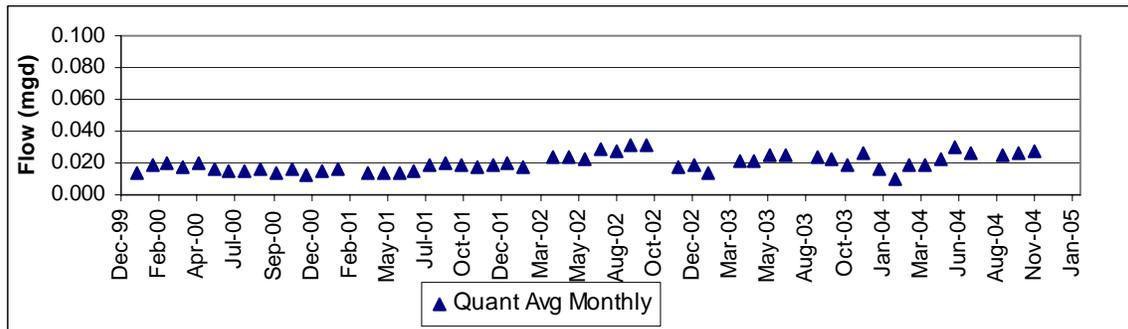


Figure B.60: Concord Beverage IWWTP MP001 CBOD5 Quantity

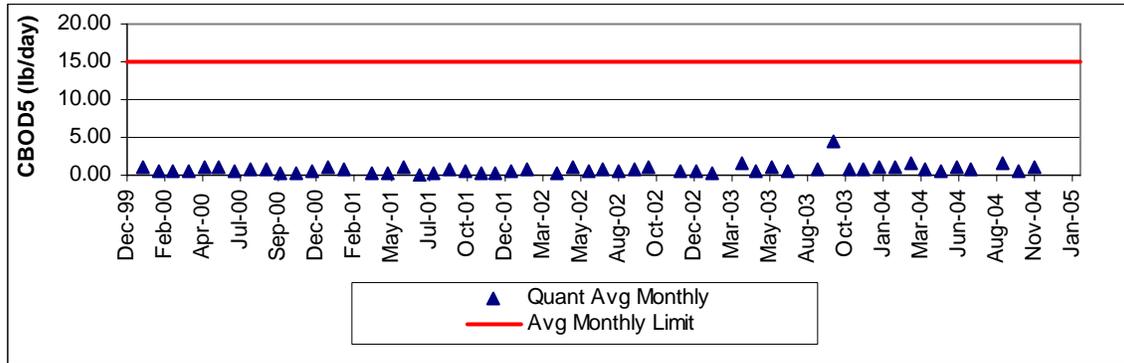


Figure B.61: Concord Beverage IWWTP MP001 CBOD5 Concentration

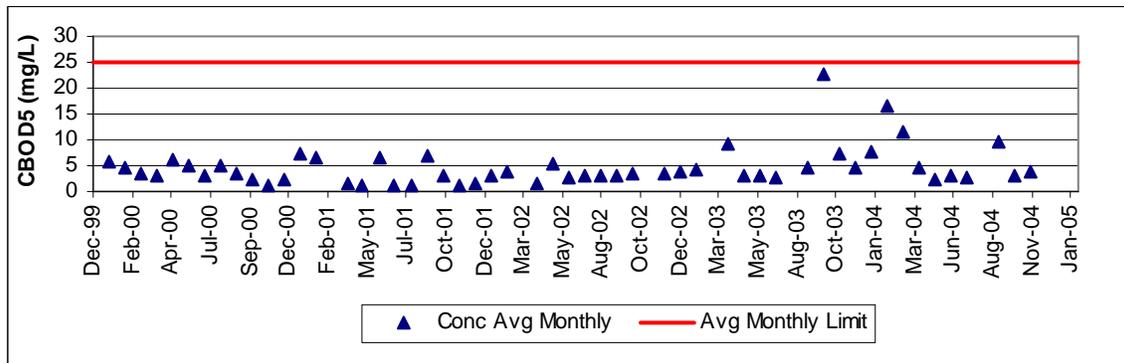


Figure B.62: Concord Beverage IWWTP MP001 pH Concentration

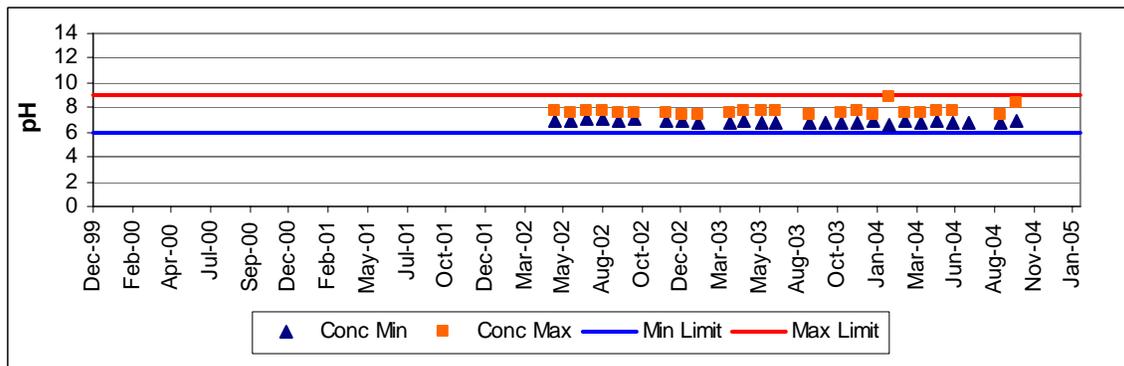


Figure B.63: Concord Beverage IWWTP MP001 TSS Quantity

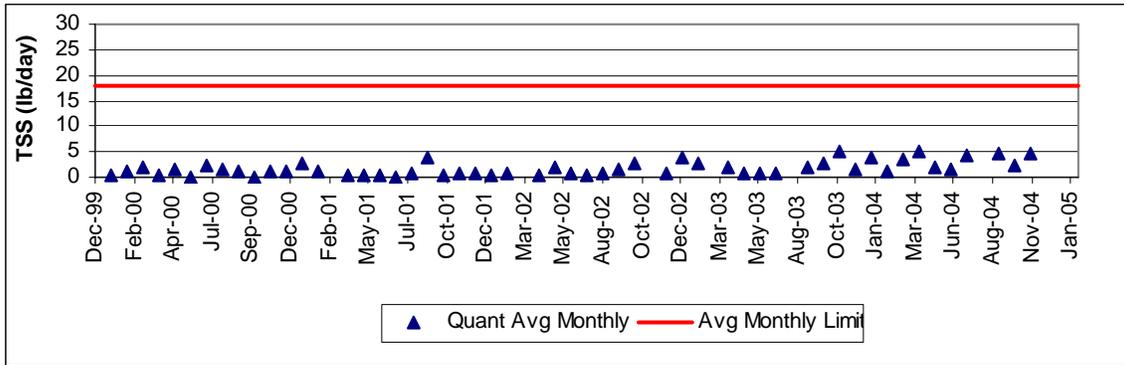


Figure B.64: Concord Beverage IWWTP MP001 TSS Concentration

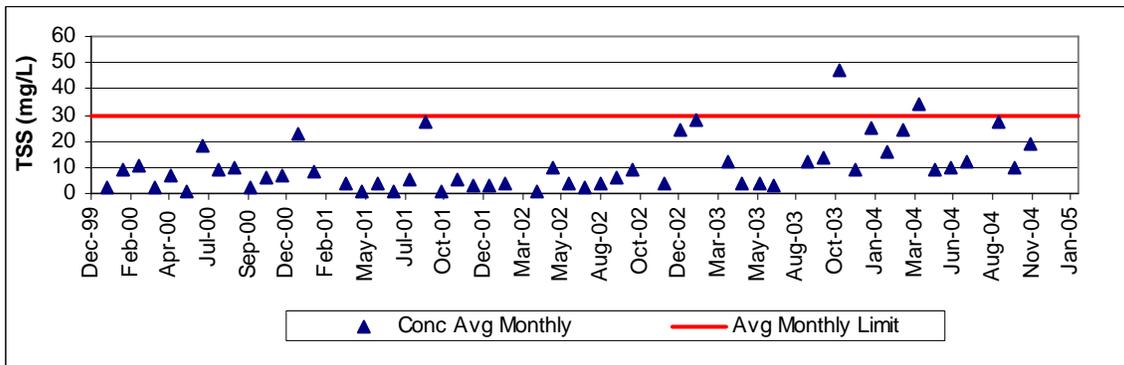


Figure B.65: Concord Beverage IWWTP MP001 Dissolved Oxygen Concentration

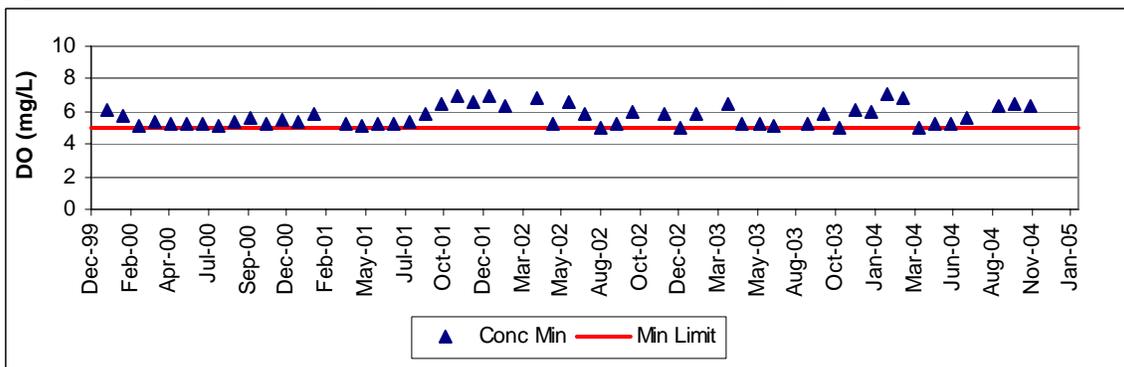


Figure B.66: Concord Beverage IWWTP MP001 Ammonia Quantity

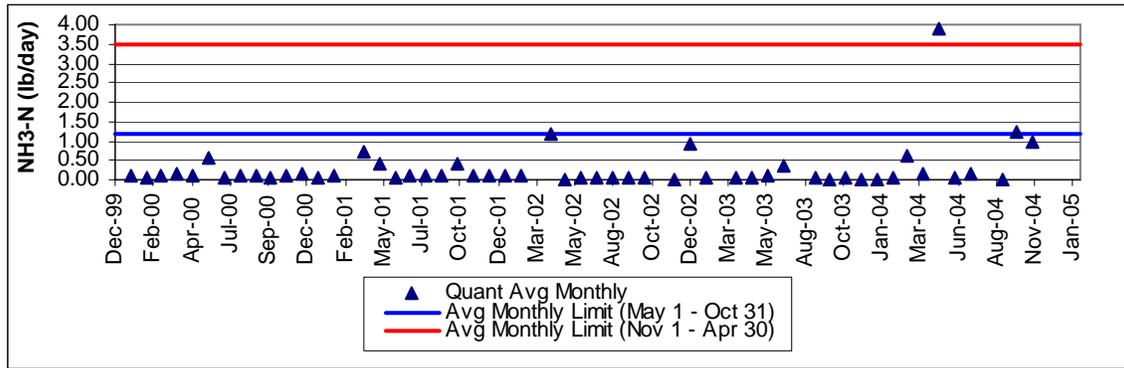


Figure B.67: Concord Beverage IWWTP MP001 Ammonia Concentration

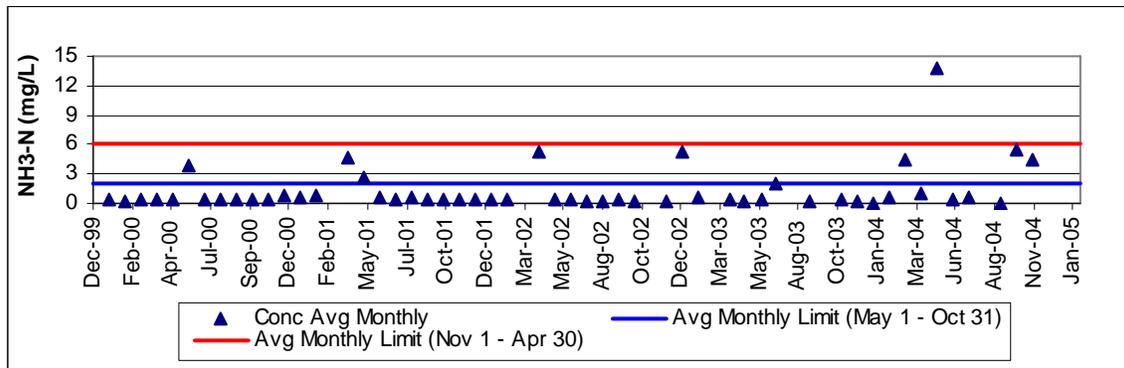


Figure B.68: Concord Beverage IWWTP 001 Flow Quantity

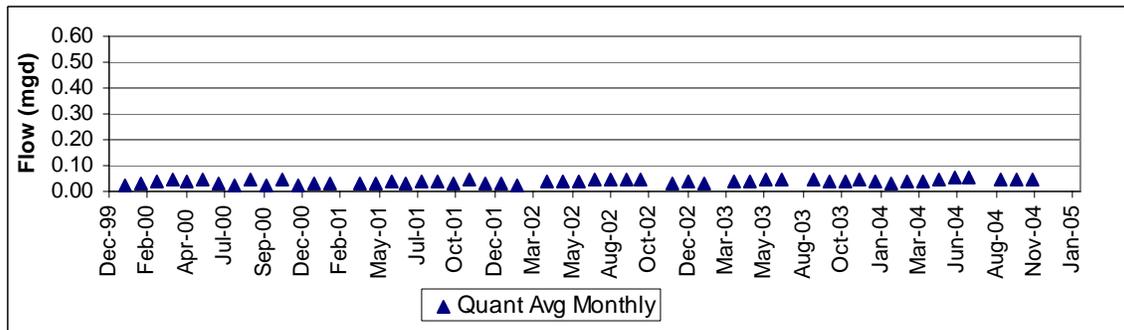


Figure B.69: Concord Beverage IWWTP 001 Oil and Grease Concentration

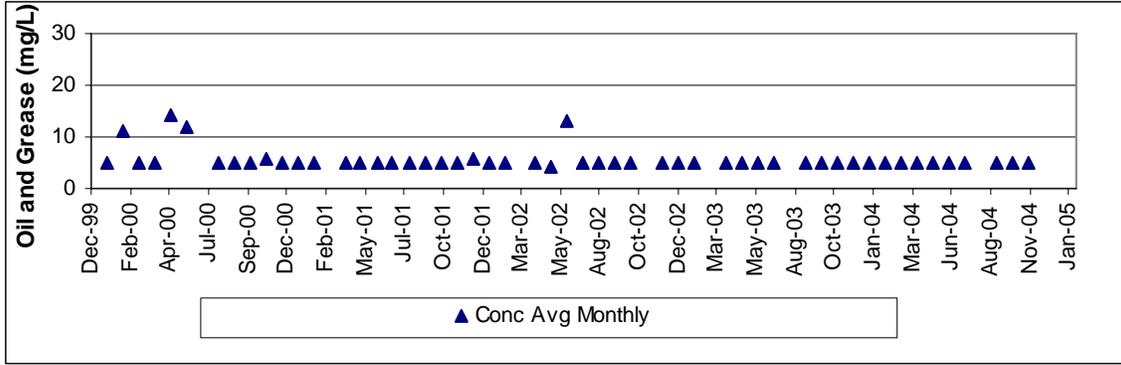


Figure B.70: Concord Beverage IWWTP 001 pH Concentration

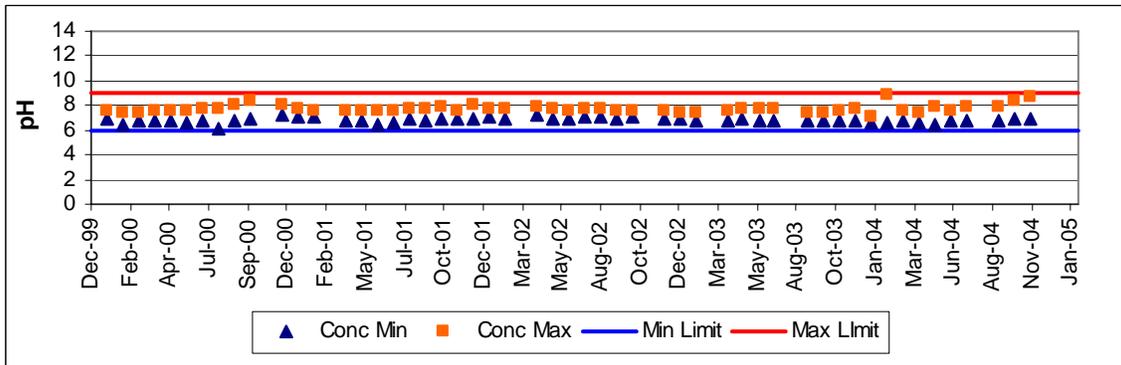


Figure B.71: Concord Beverage IWWTP 001 Temperature Concentration

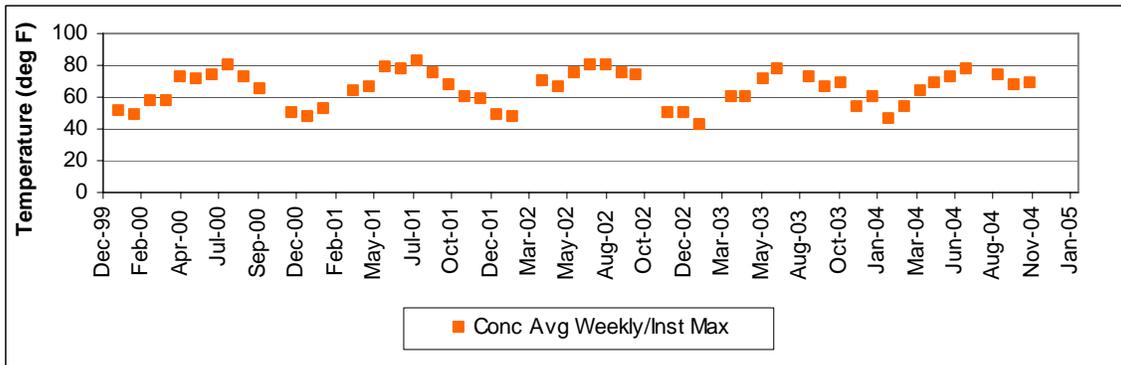


Figure B.72: Concord Beverage IWWTP 001 Total Dissolved Solids Concentration

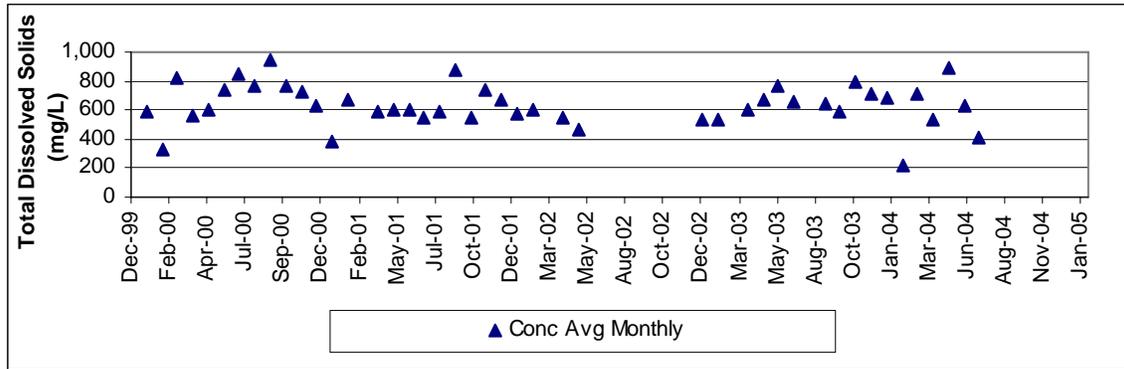


Figure B.73: Fox Valley Community WWTP Flow Quantity

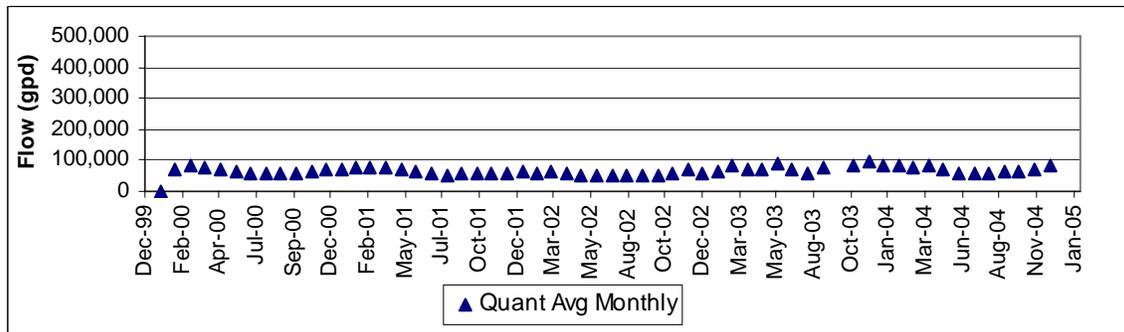


Figure B.74: Fox Valley Community WWTP CBOD5 Quantity

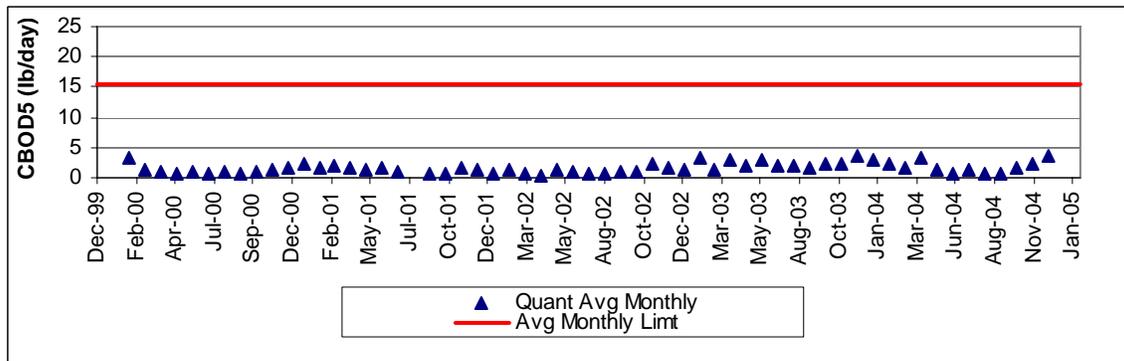


Figure B.75: Fox Valley Community WWTP CBOD5 Concentration

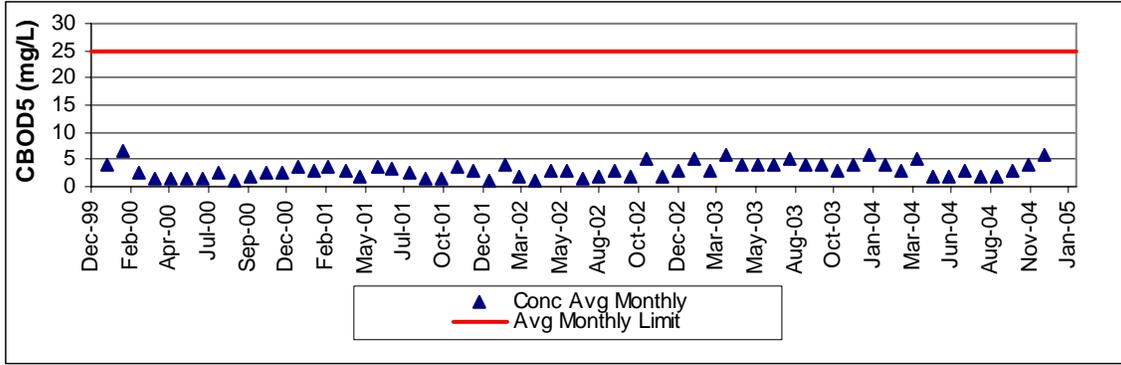


Figure B.76: Fox Valley Community WWTP pH Concentration

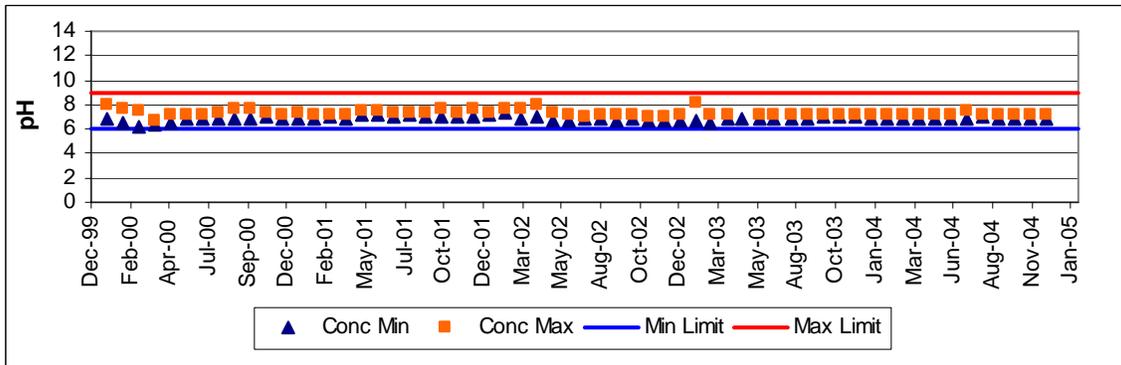


Figure B.77: Fox Valley Community WWTP TSS Quantity

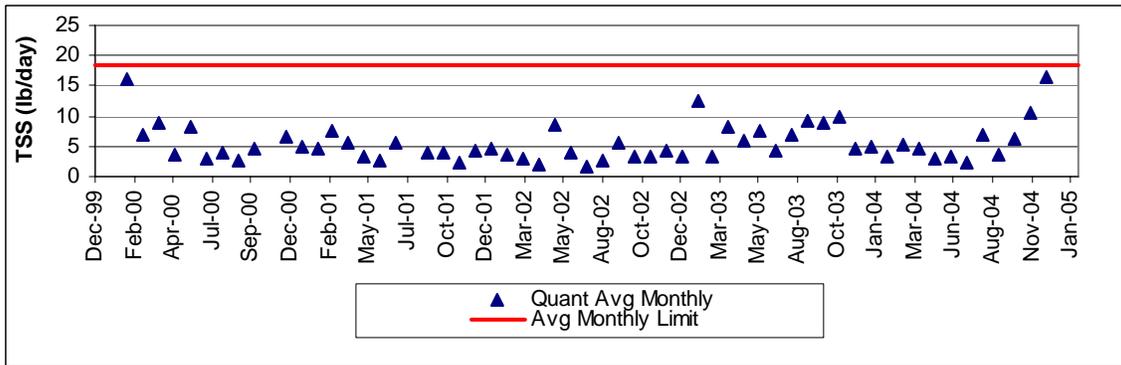


Figure B.78: Fox Valley Community WWTP TSS Concentration

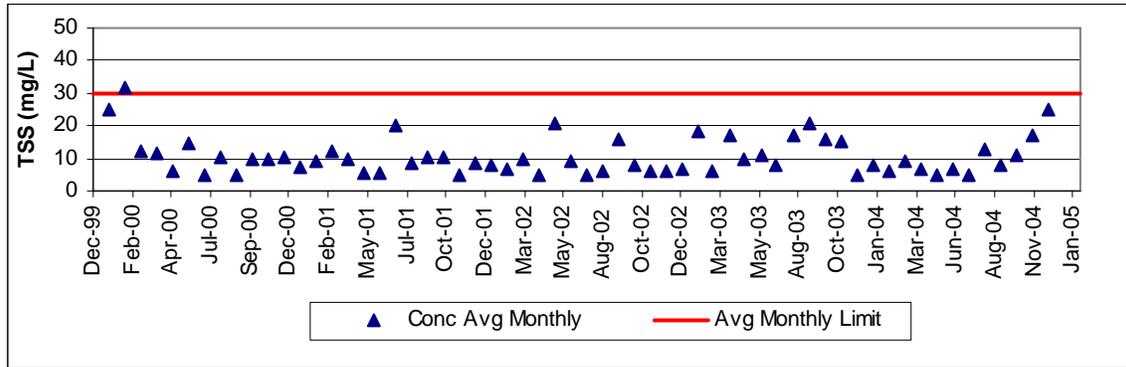


Figure B.79: Fox Valley Community WWTP Dissolved Oxygen Concentration

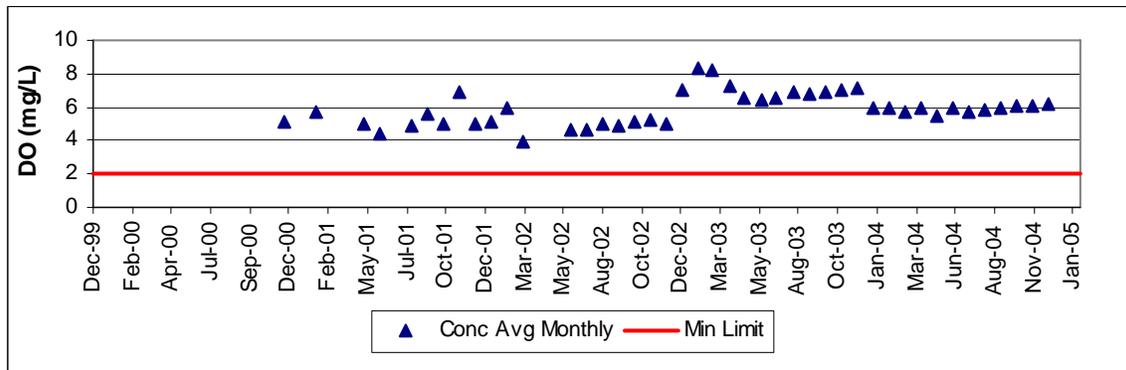


Figure B.80: Fox Valley Community WWTP Ammonia Quantity

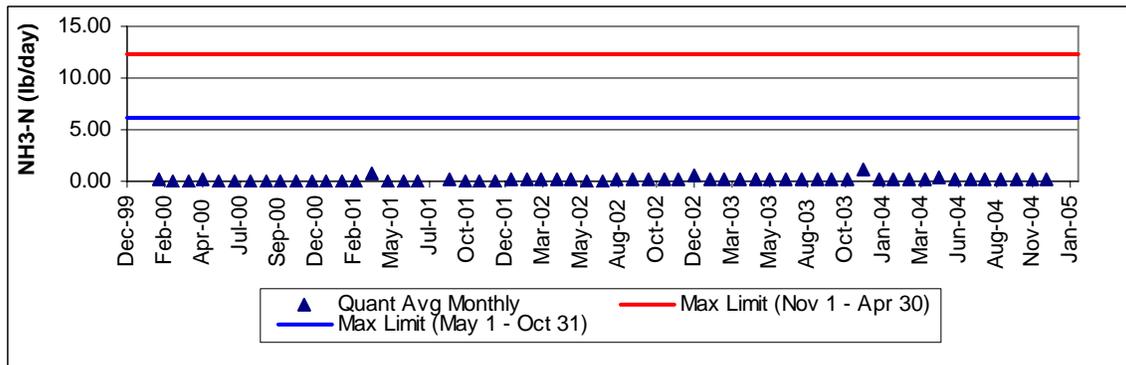


Figure B.81: Fox Valley Community WWTP AMMONIA Concentration

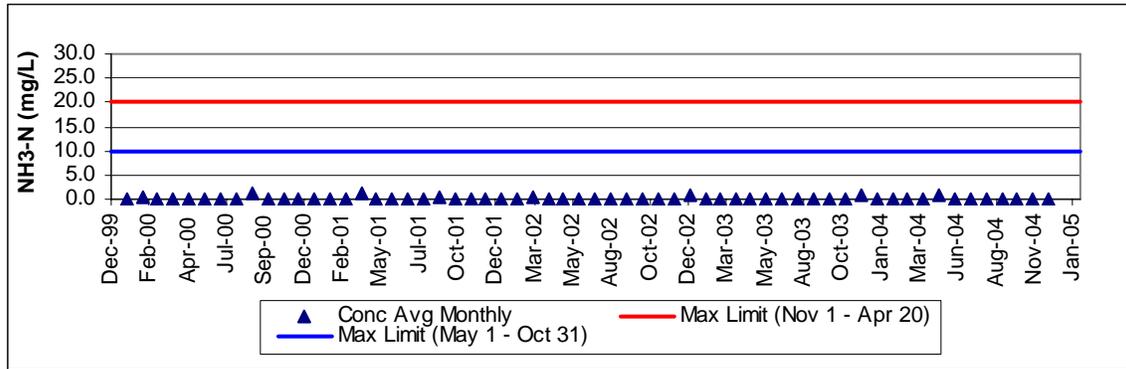


Figure B.82: Fox Valley Community WWTP Fecal Coliform Concentration

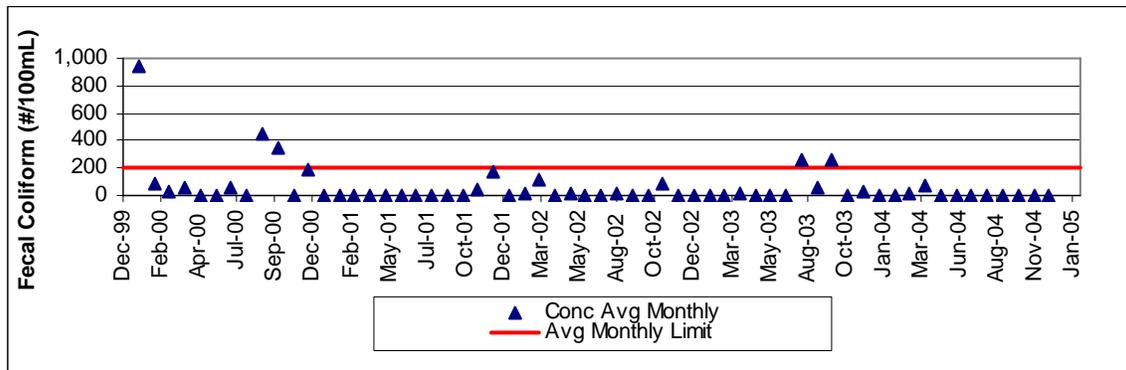


Figure B.83: Fox Valley Community WWTP TRC Concentration

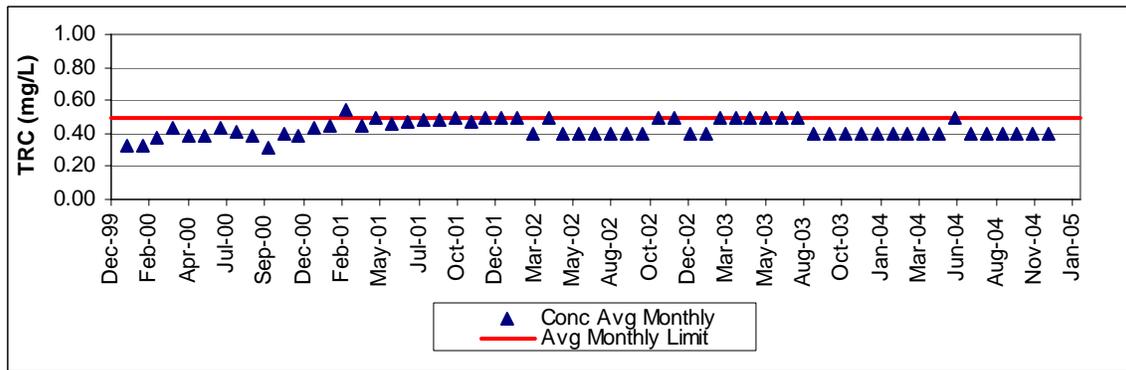


Figure B.84: Concord Industrial Park STP Flow Quantity

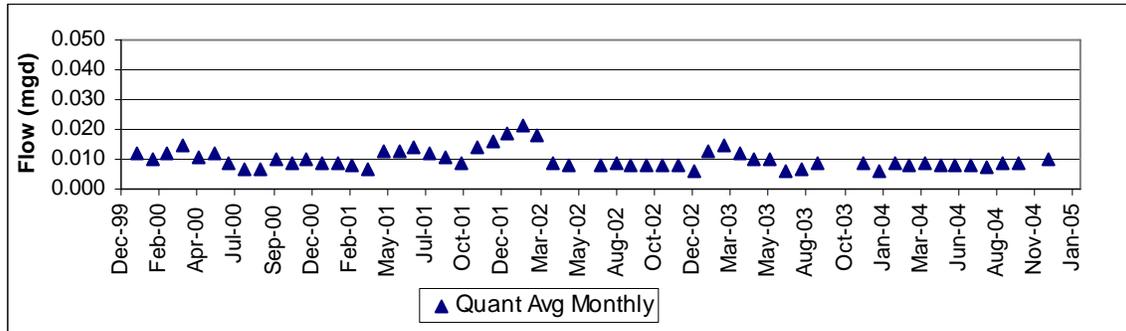


Figure B.85: Concord Industrial Park STP CBOD5 Quantity

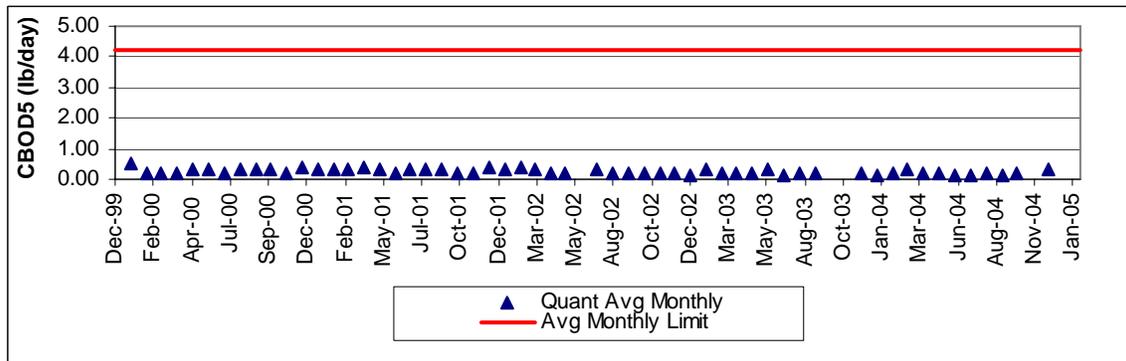


Figure B.86: Concord Industrial Park STP CBOD5 Concentration

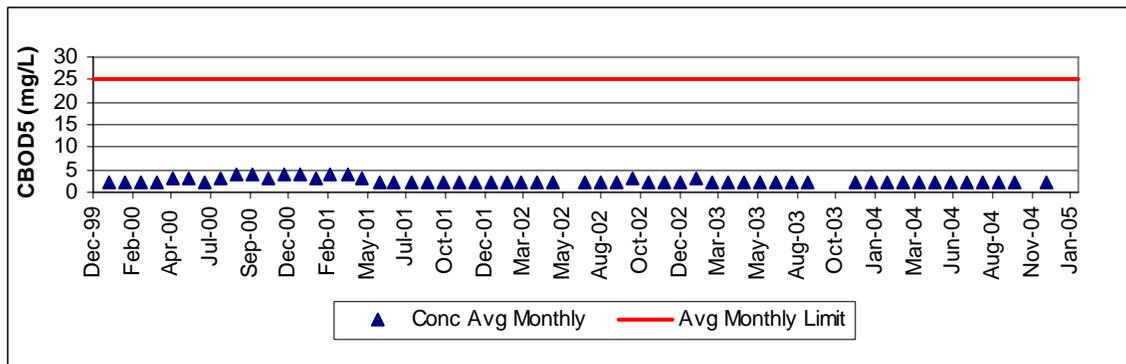


Figure B.87: Concord Industrial Park STP pH Concentration

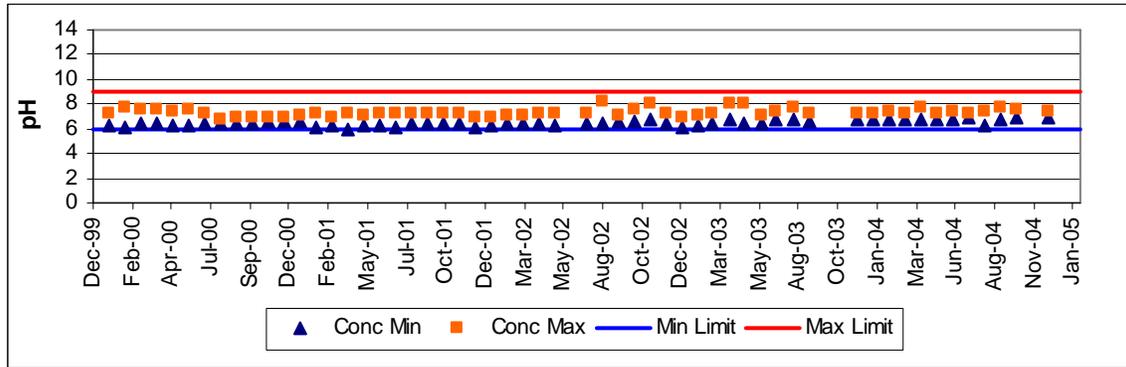


Figure B.88: Concord Industrial Park STP TSS Quantity

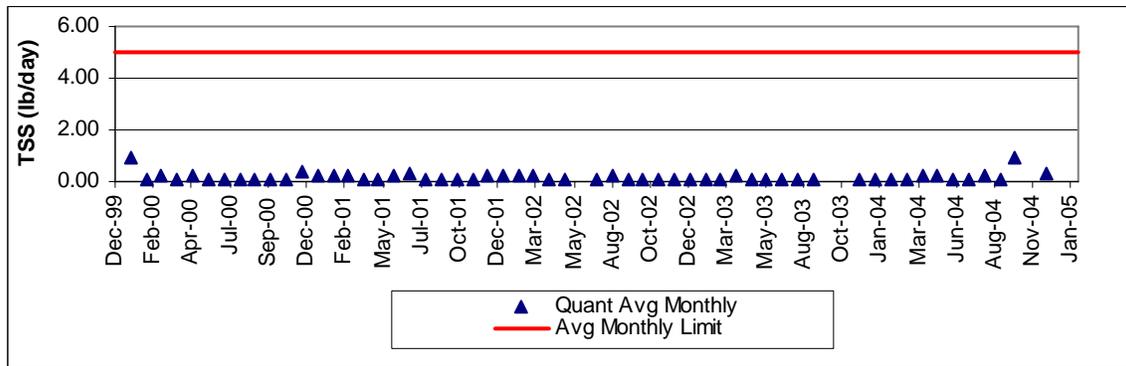


Figure B.89: Concord Industrial Park STP TSS Concentration

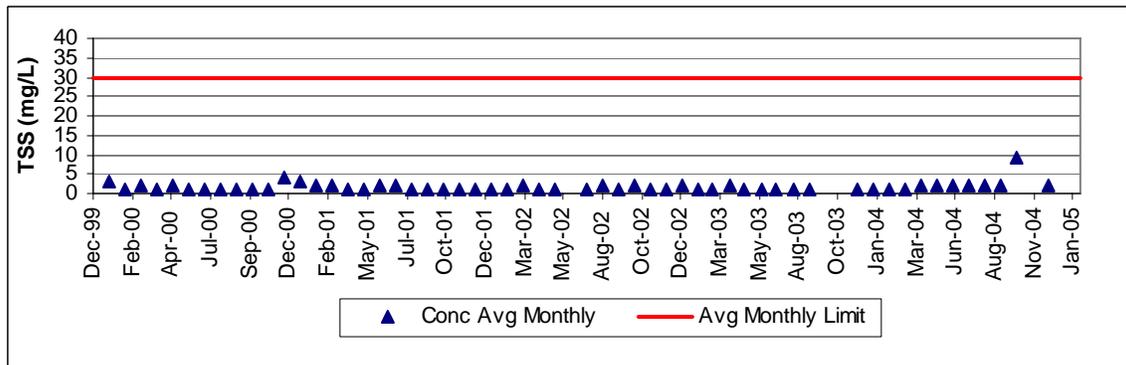


Figure B.90: Concord Industrial Park STP Dissolved Oxygen Concentration

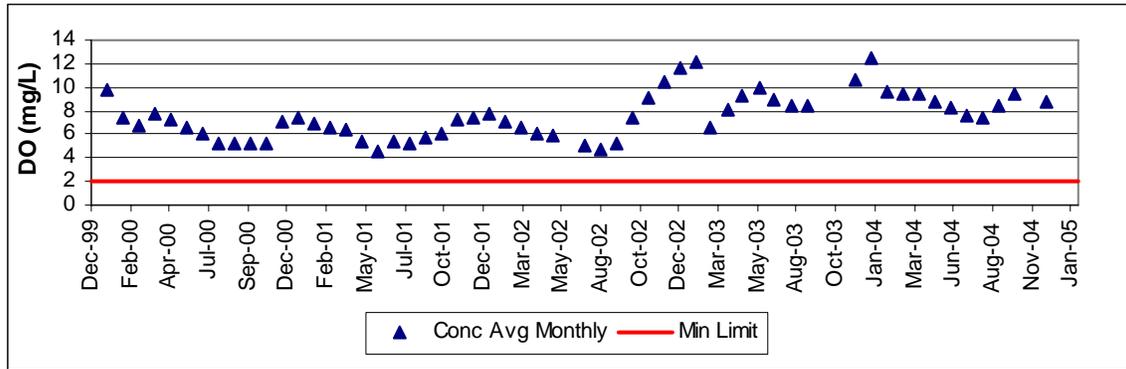


Figure B.91: Concord Industrial Park STP Ammonia Concentration

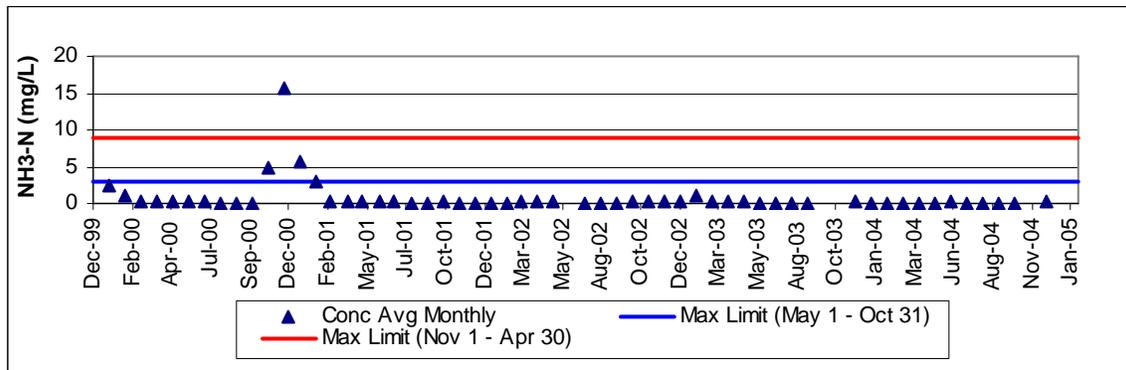


Figure B.92: Concord Industrial Park STP Fecal Coliform Concentration

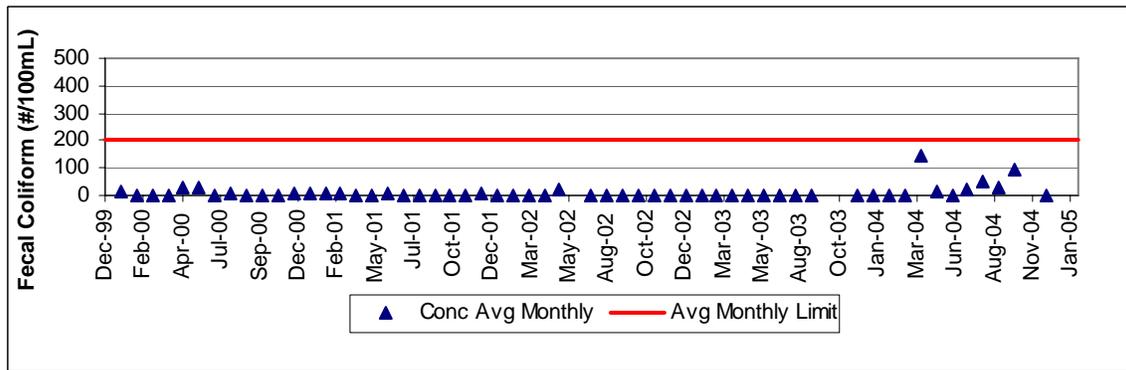


Figure B.93: Concord Industrial Park STP TRC Concentration

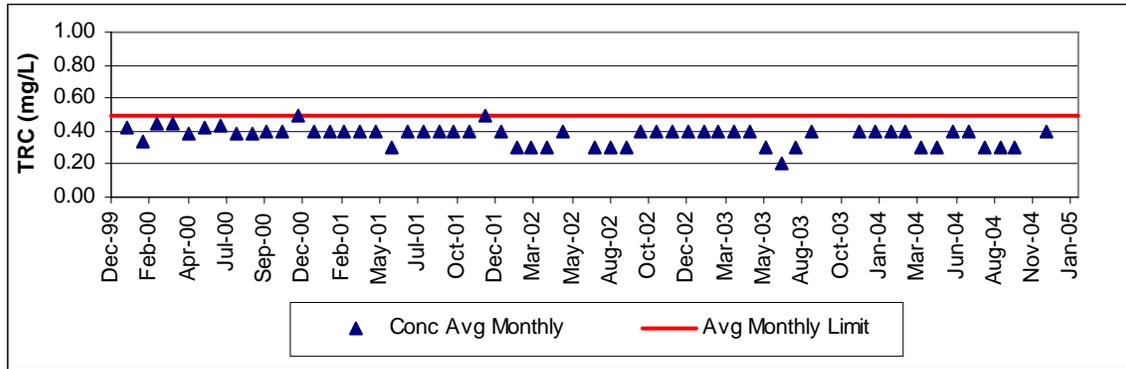


Figure B.94: Valleybrook Homeowners Association STP Flow Quantity

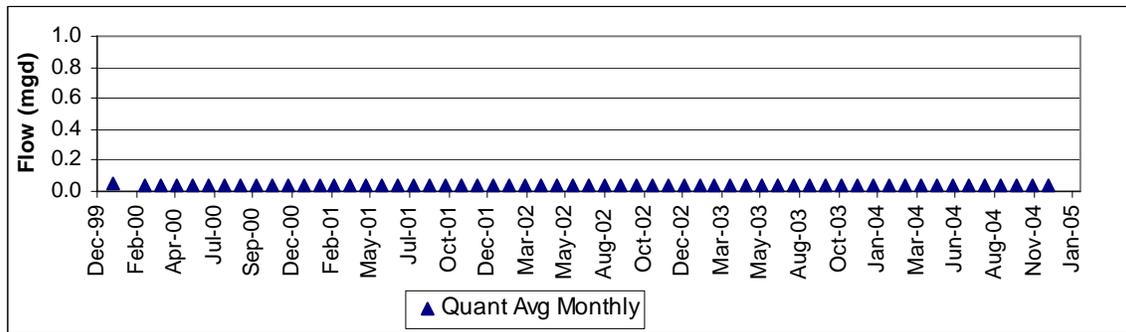


Figure B.95: Valleybrook Homeowners Association STP CBOD5 Concentration

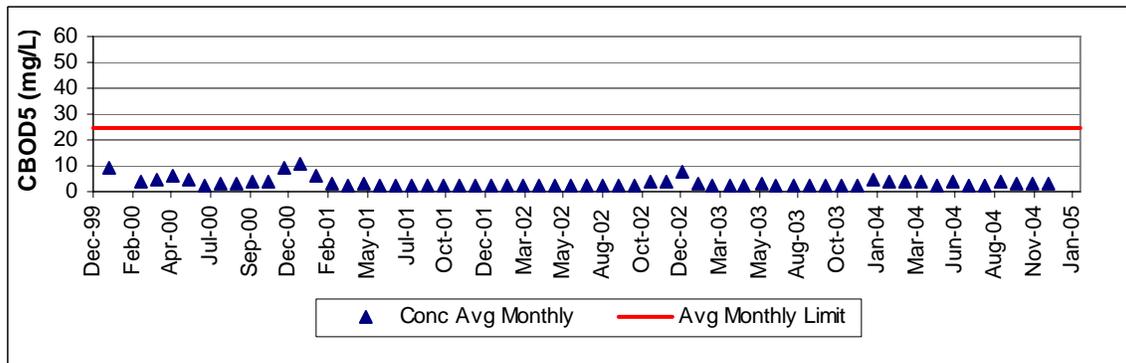


Figure B.96: Valleybrook Homeowners Association STP pH Concentration

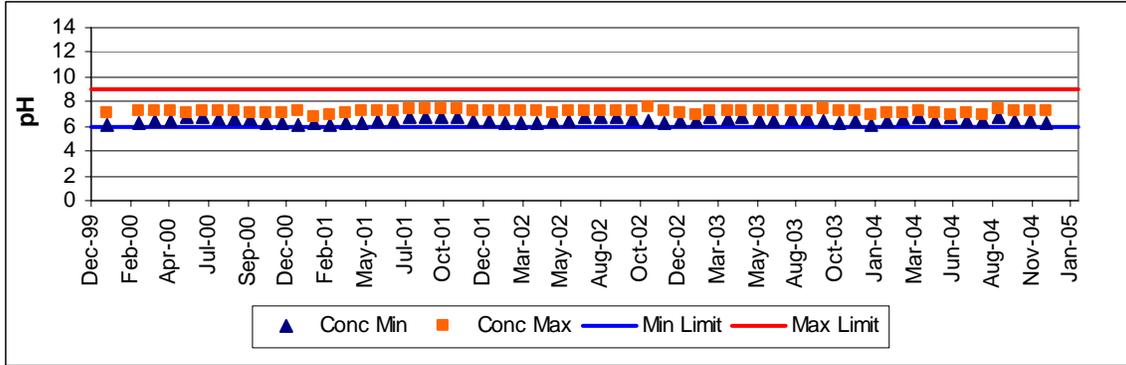


Figure B.97: Valleybrook Homeowners Association STP TSS Concentration

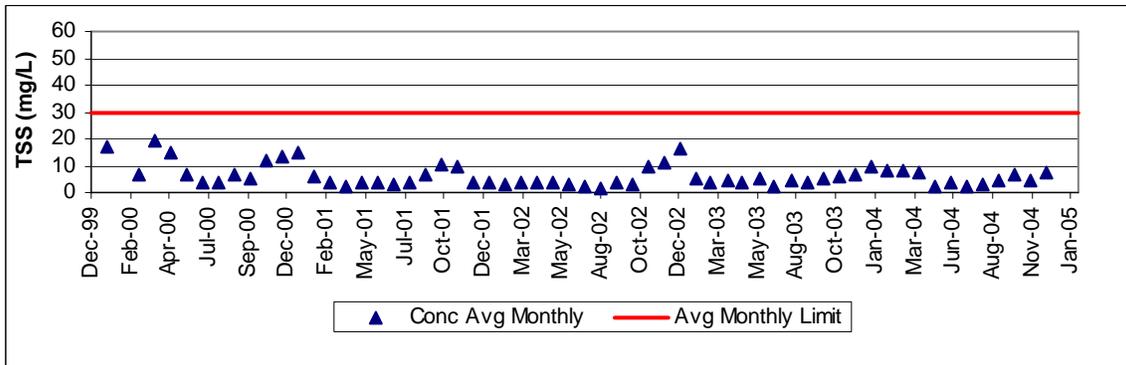


Figure B.98: Valleybrook Homeowners Association STPDissolved Oxygen Concentration

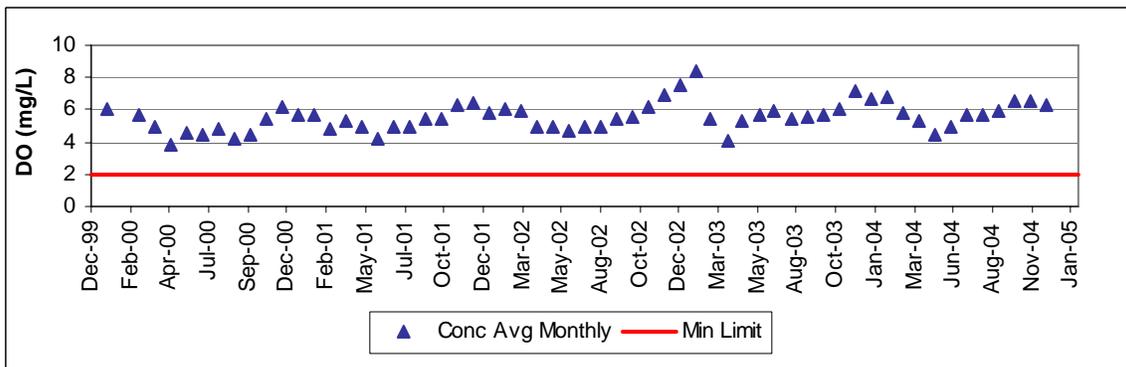


Figure B.99: Valleybrook Homeowners Association STP Ammonia Concentration

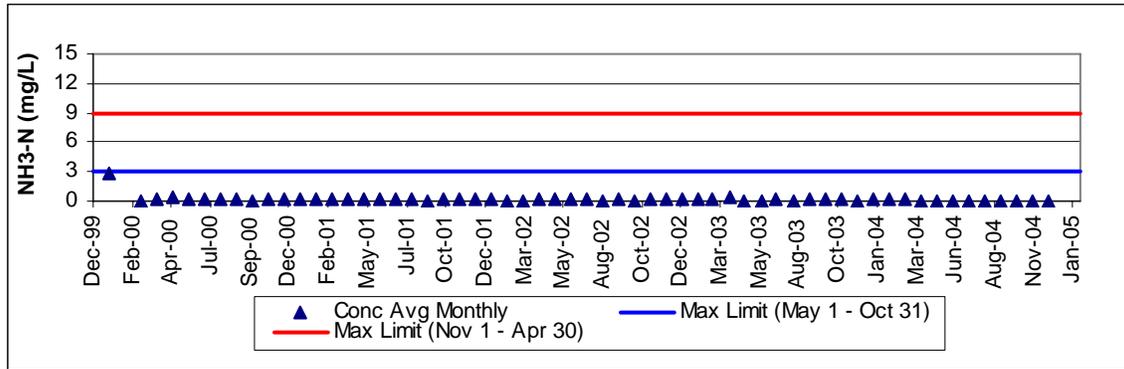


Figure B.100: Valleybrook Homeowners Association STP Fecal Coliform Concentration

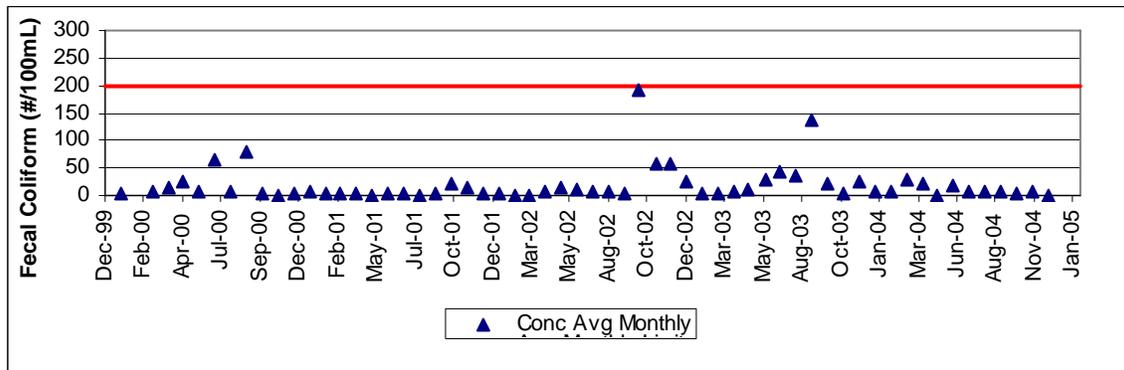


Figure B.101: Valleybrook Homeowners Association STP TRC Concentration

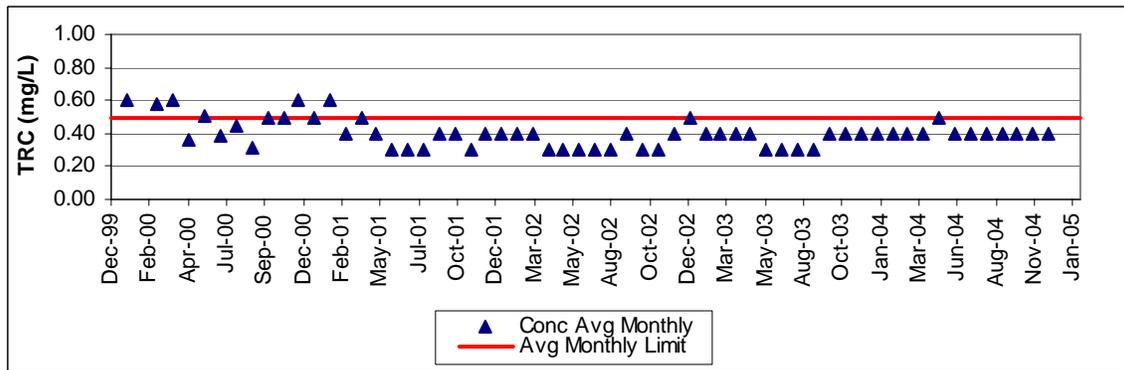


Figure B.102: Concord Township Central STP Average Flow

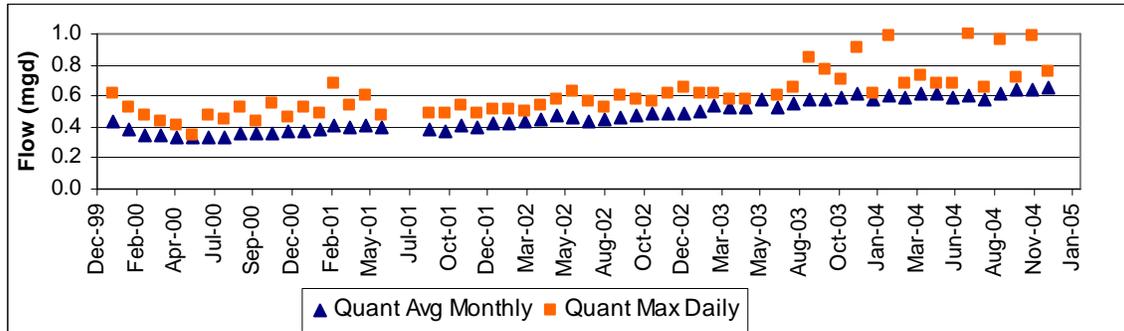


Figure B.103: Concord Township Central STP CBOD5 Quantity

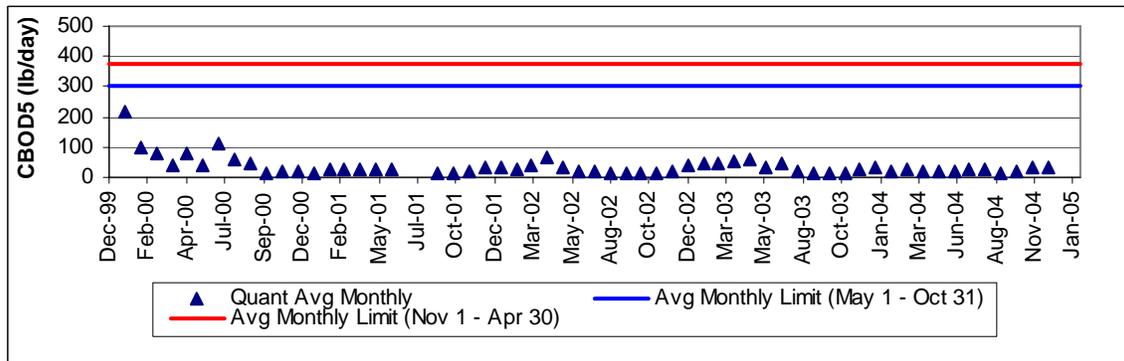


Figure B.104: Concord Township Central STP CBOD5 Concentration

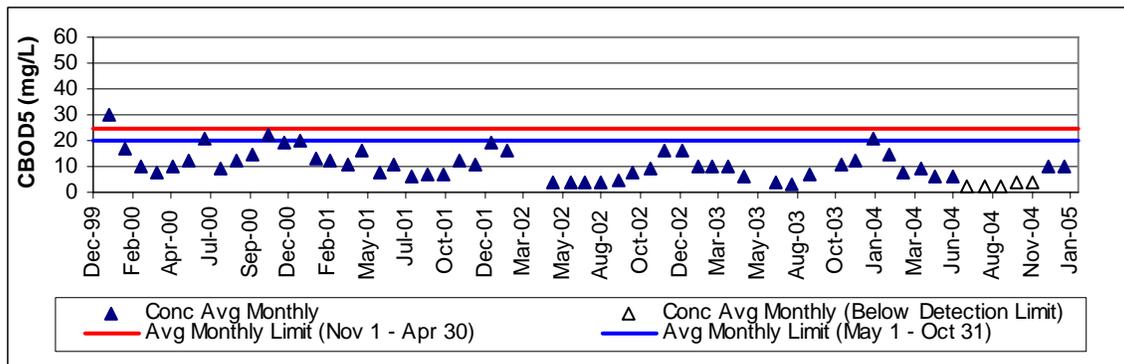


Figure B.105: Concord Township Central STP pH Concentration

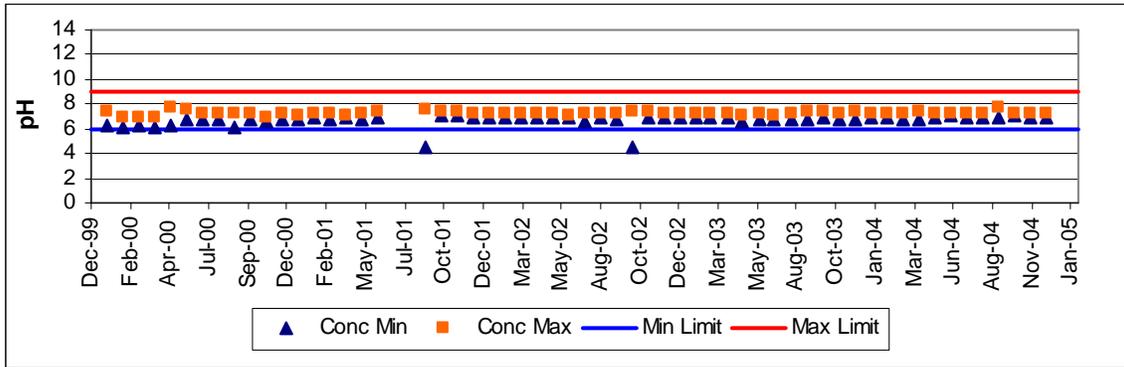


Figure B.106: Concord Township Central STP TSS Quantity

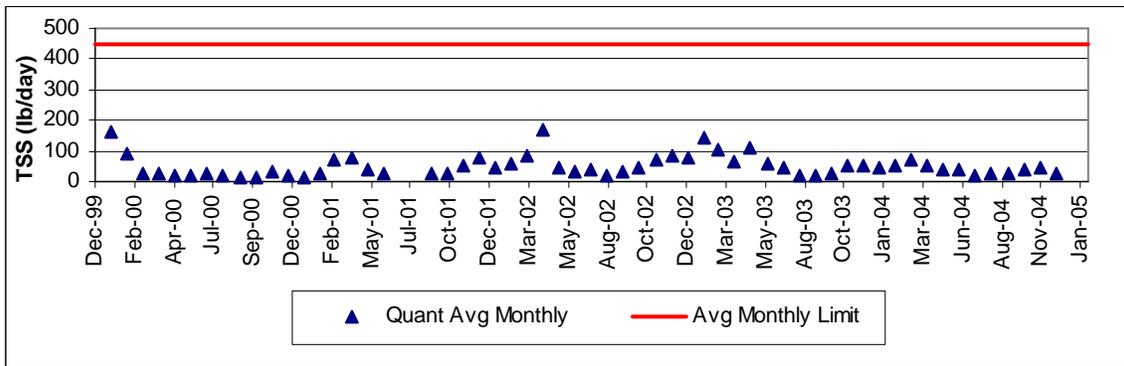


Figure B.107: Concord Township Central STP TSS Concentration

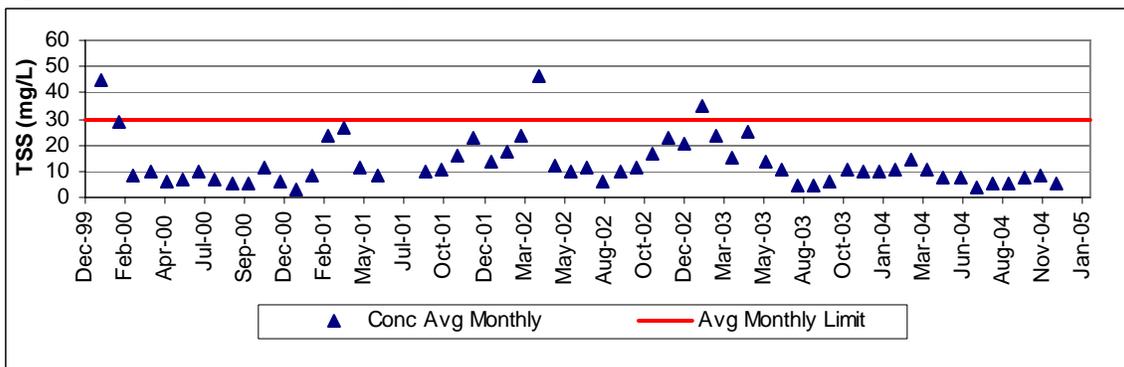


Figure B.108: Concord Township Central STP Dissolved Oxygen Concentration

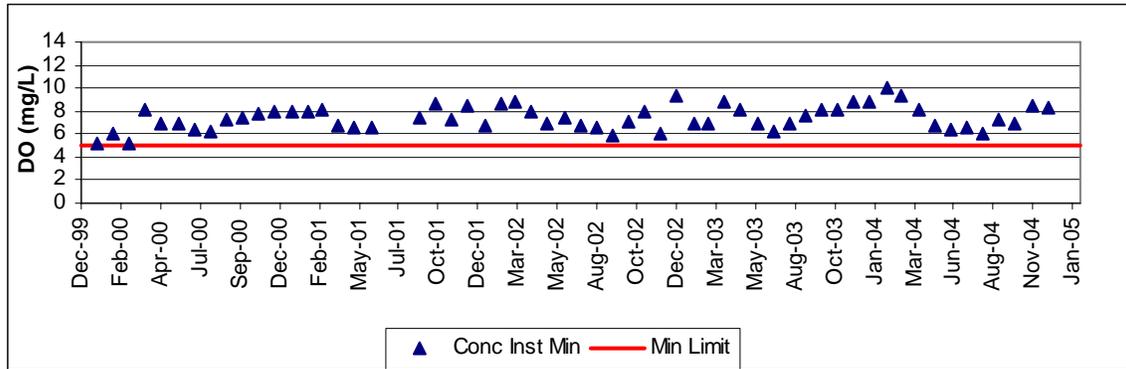


Figure B.109: Concord Township Central STP Fecal Coliform Concentration

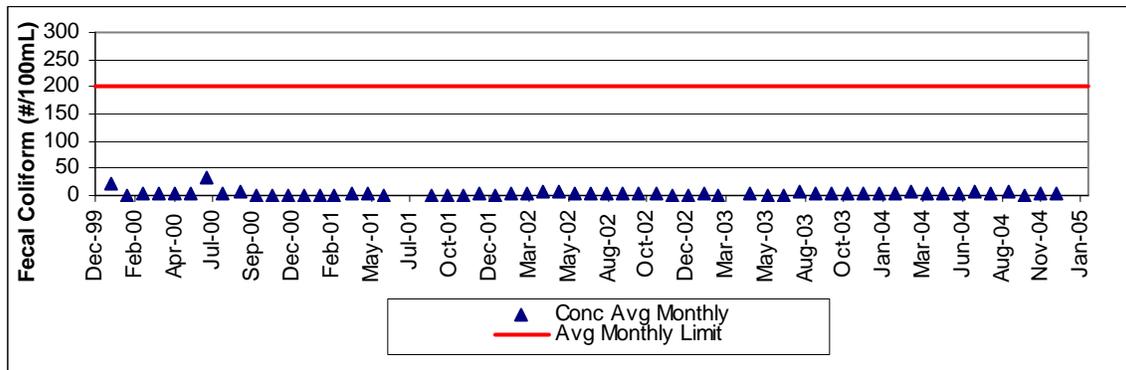


Figure B.110: Concord Township Central STP Ammonia Quantity

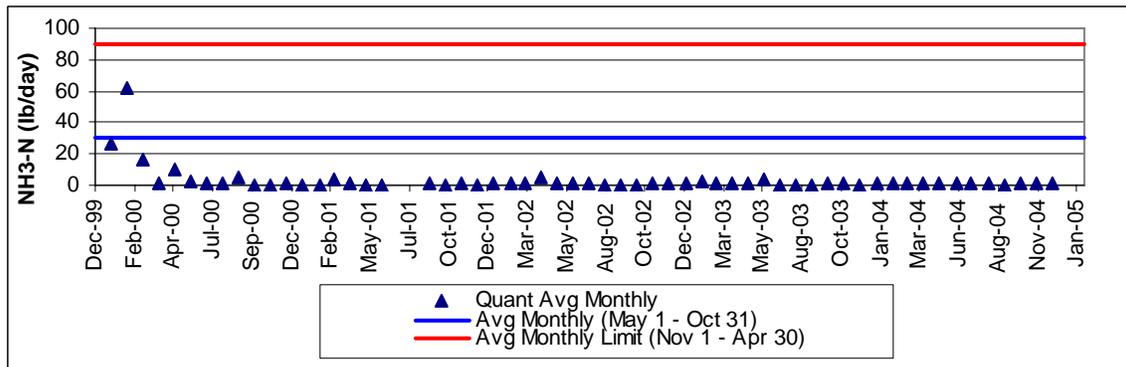


Figure B.111: Concord Township Central STP Ammonia Concentration

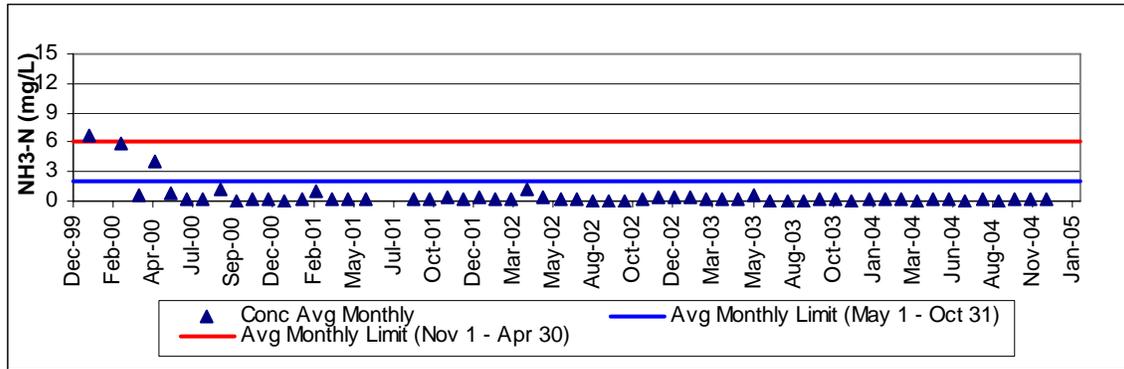


Figure B.112: Concord Township Central STP Phosphorous Concentration

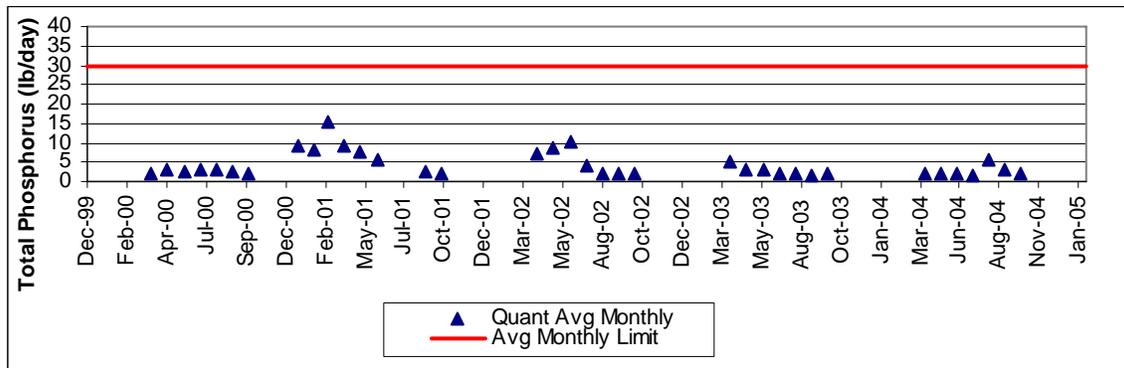


Figure B.113: Concord Township Central STP TRC Concentration

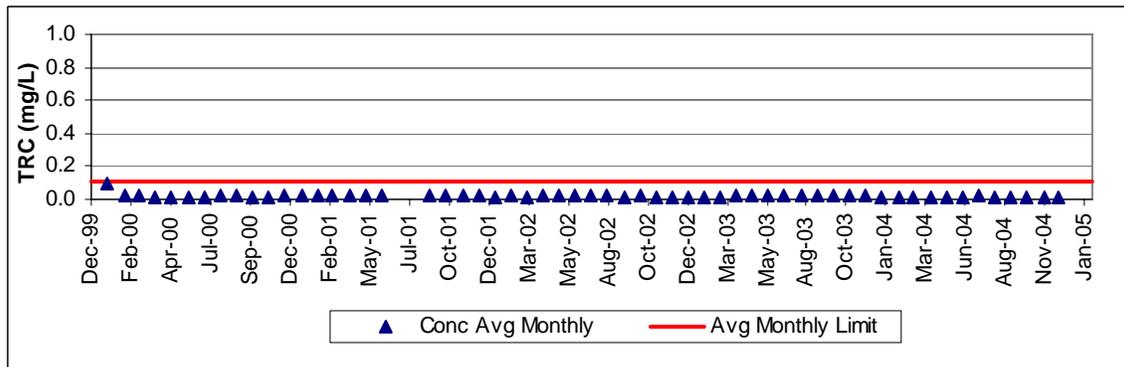


Figure B.114: Laurel Pipe Line Company Outfall MP101 Flow Quantity

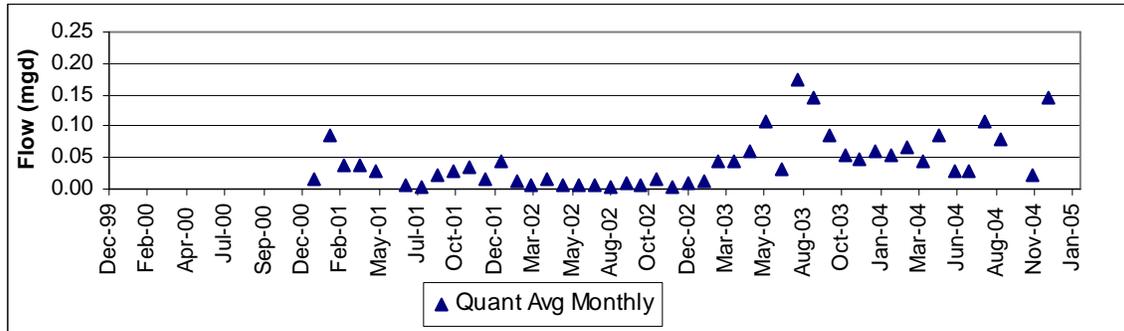


Figure B.115: Laurel Pipe Line Company Outfall MP101 Benzene Concentration

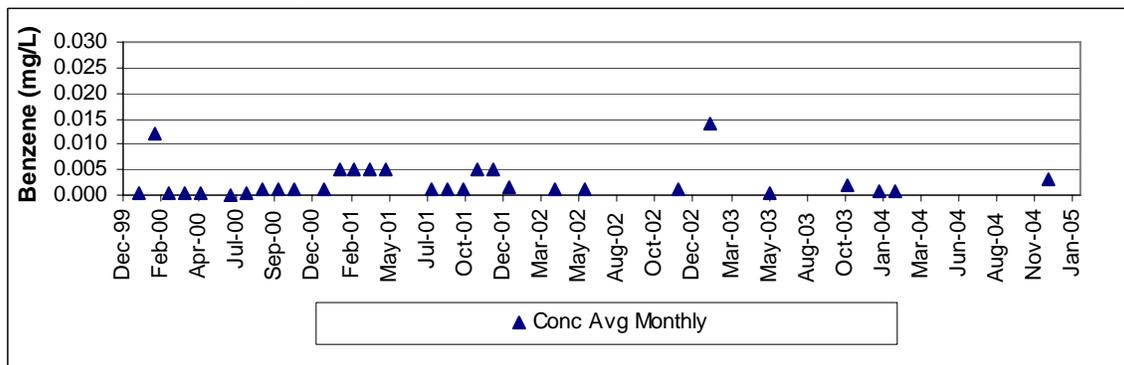


Figure B.116: Laurel Pipe Line Company Outfall MP101 Ethylbenzene Concentration

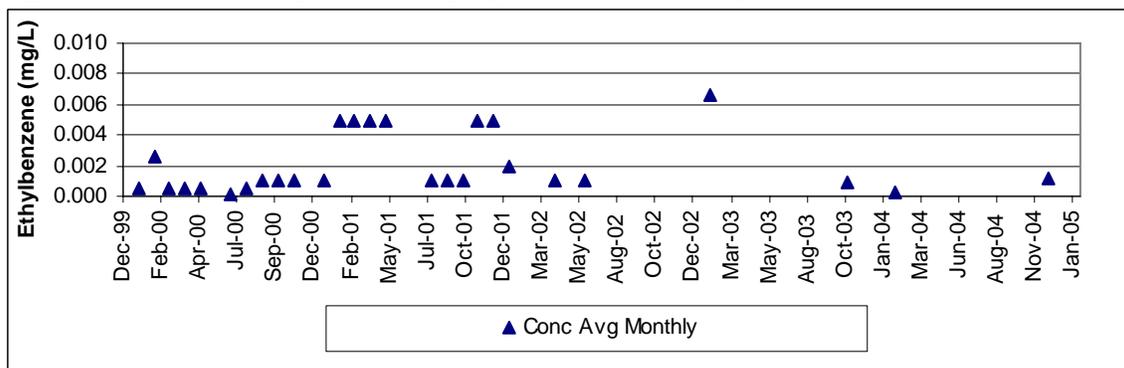


Figure B.117: Laurel Pipe Line Company Outfall MP101 pH Concentration

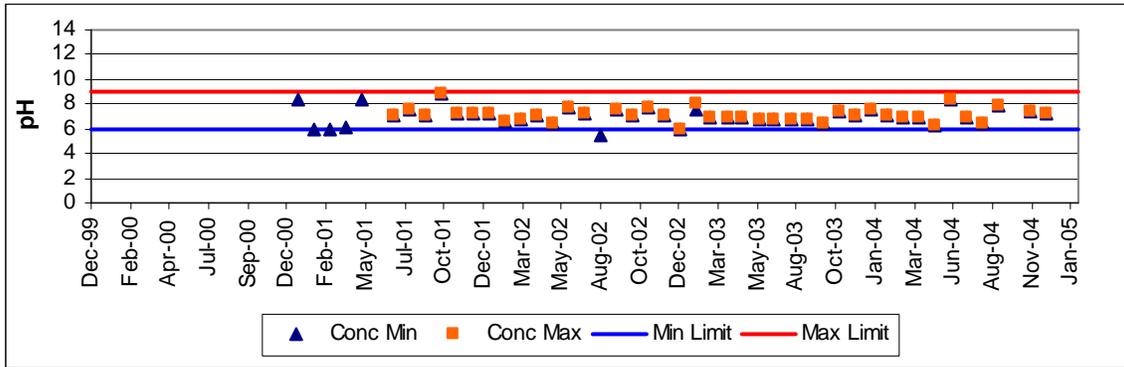


Figure B.118: Laurel Pipe Line Company Outfall MP101 Toluene Concentration

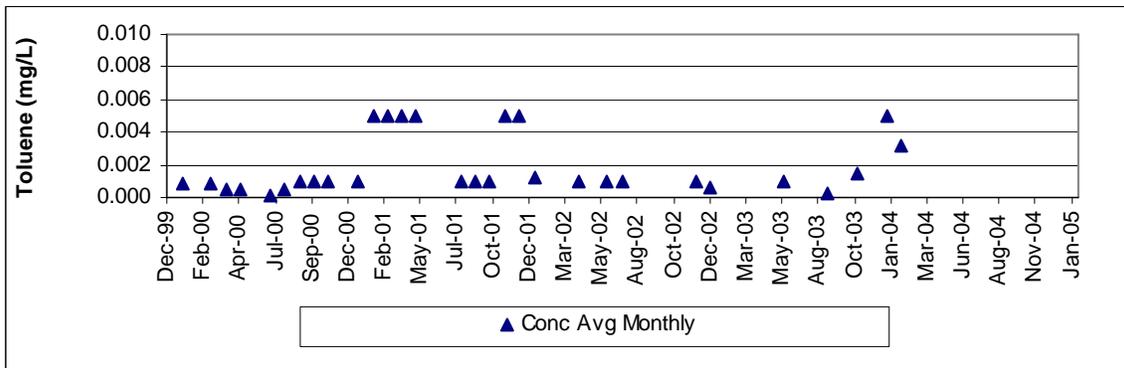


Figure B.119: Laurel Pipe Line Company Outfall MP101 BETX Concentration

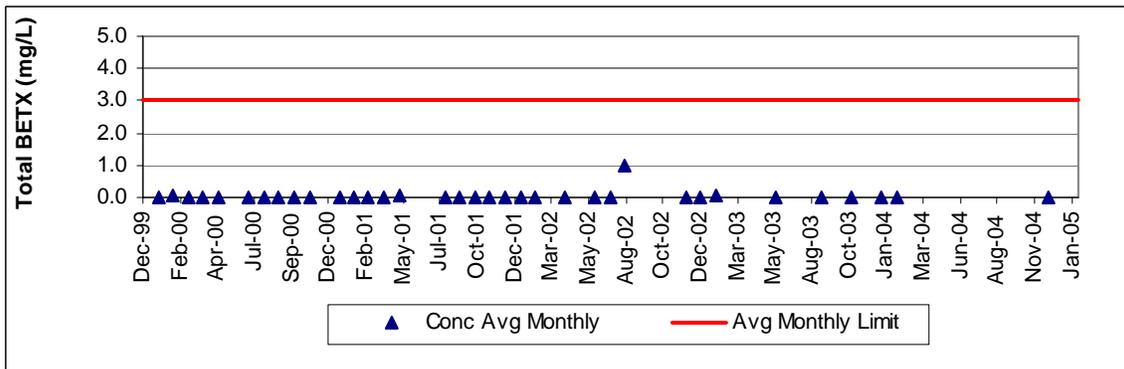


Figure B.120: Laurel Pipe Line Company Outfall MP101 Xylen Concentration

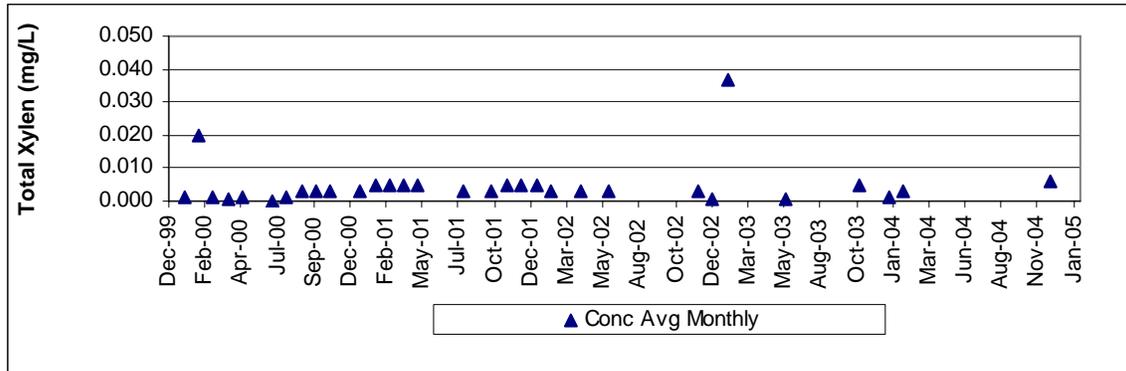


Figure B.121: Laurel Pipe Line Company Outfall 001 Oil and Grease Concentration

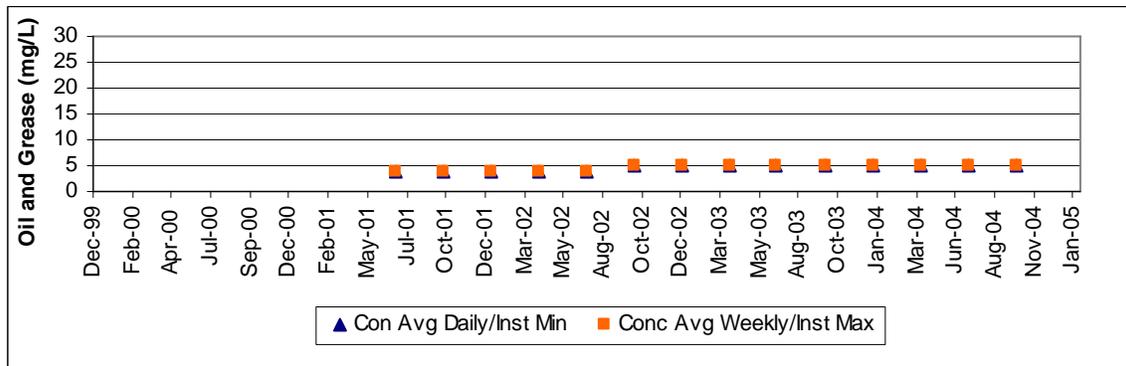


Figure B.122: Laurel Pipe Line Company Outfall 001 Oil and Grease Concentration

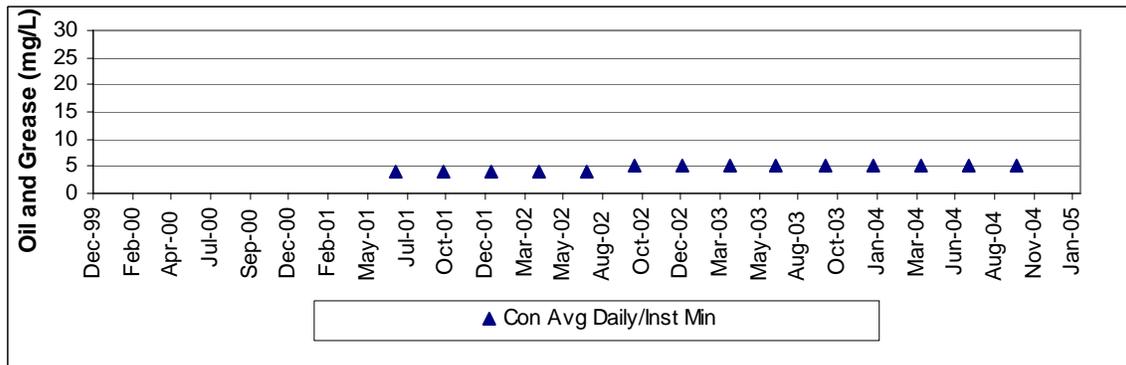


Figure B.123: Laurel Pipe Line Company Outfall 001 Diesel Range Organics Concentrations

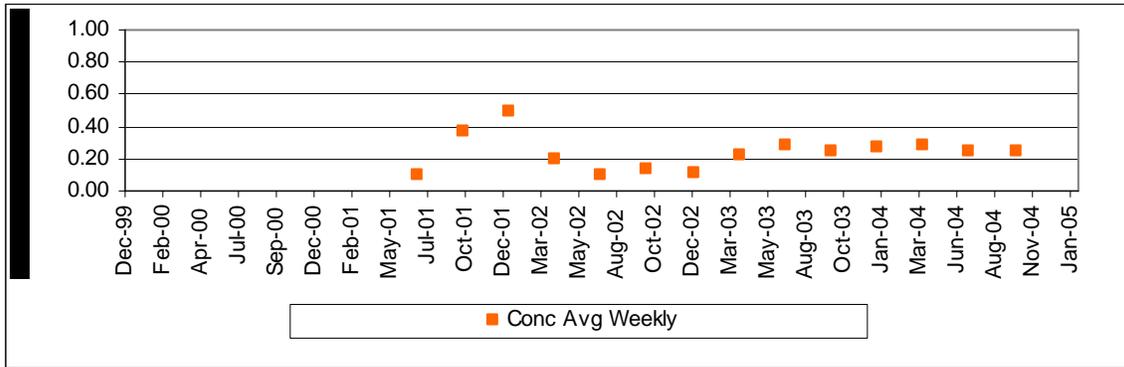


Figure B.124: Laurel Pipe Line Company Outfall 001 Dissolve Oxygen Concentration

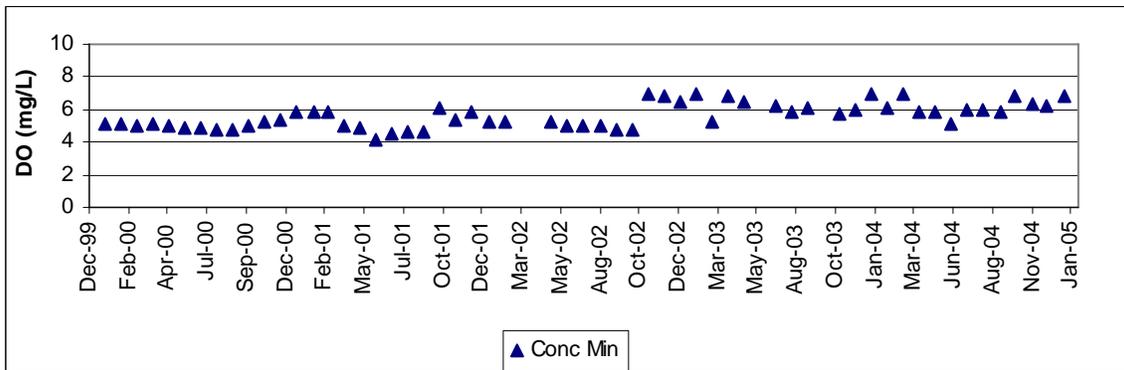


Figure B.125: Laurel Pipe Line Company Outfall 001 Copper Concentration

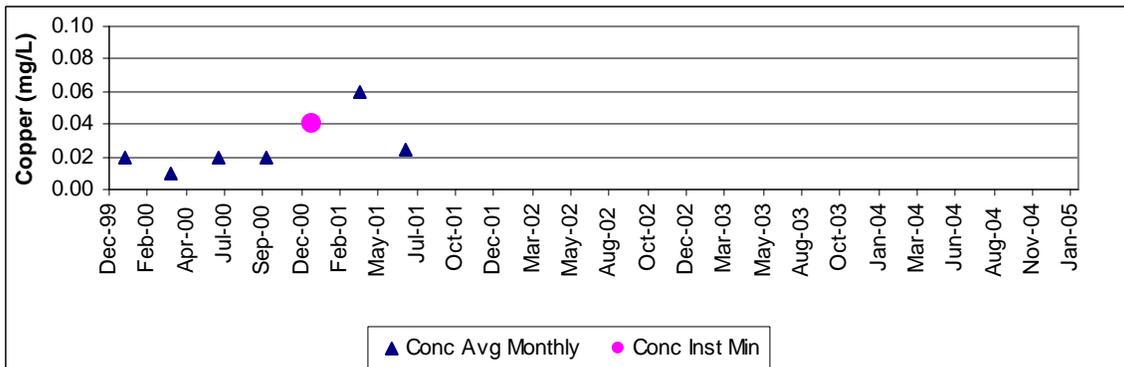


Figure B.126: Laurel Pipe Line Company Outfall 001 Ammonia Quantity

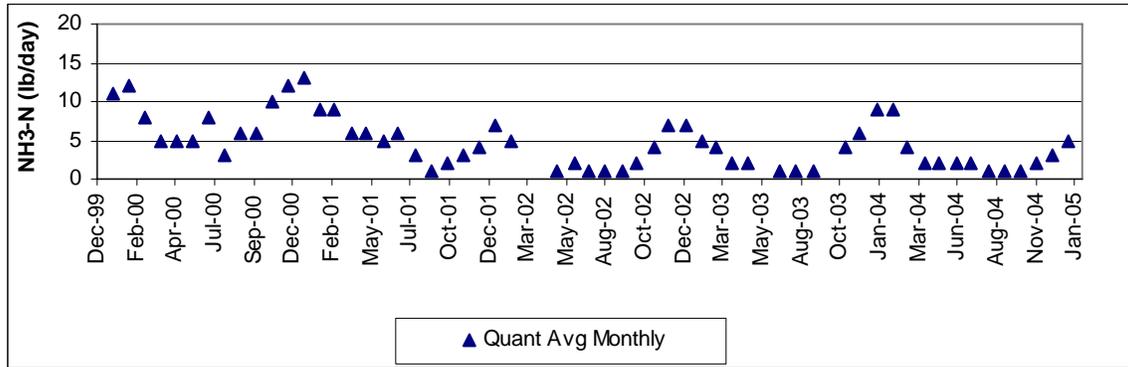


Figure B.127: Laurel Pipe Line Company Outfall 001 Ammonia Concentration

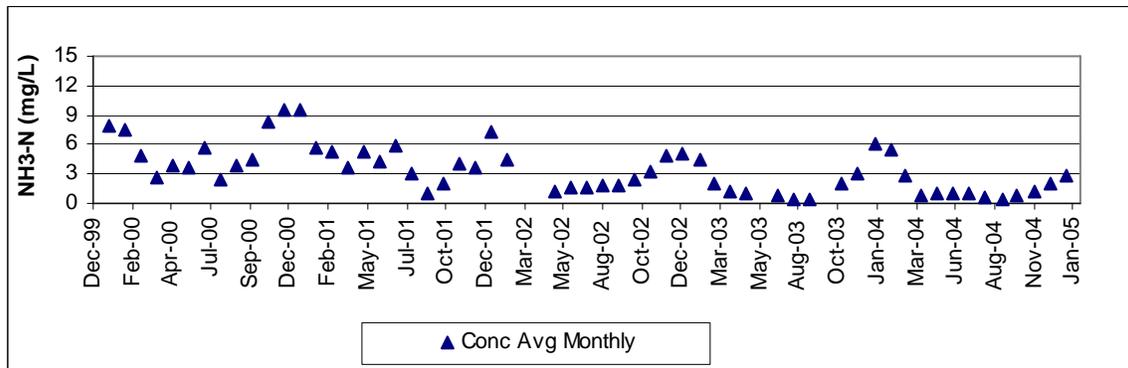


Figure B.128: Laurel Pipe Line Company Outfall 001 Fecal Coliform Concentration

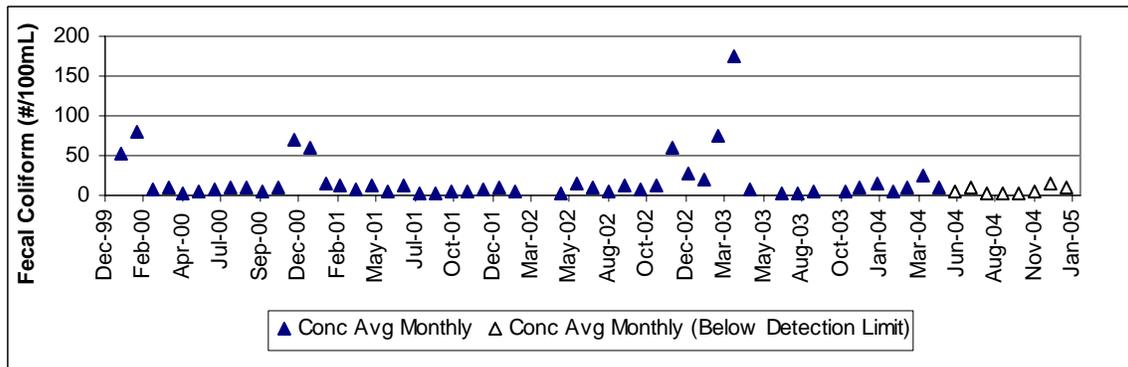


Figure B.129: Laurel Pipe Line Company Outfall 001 Zinc Concentration

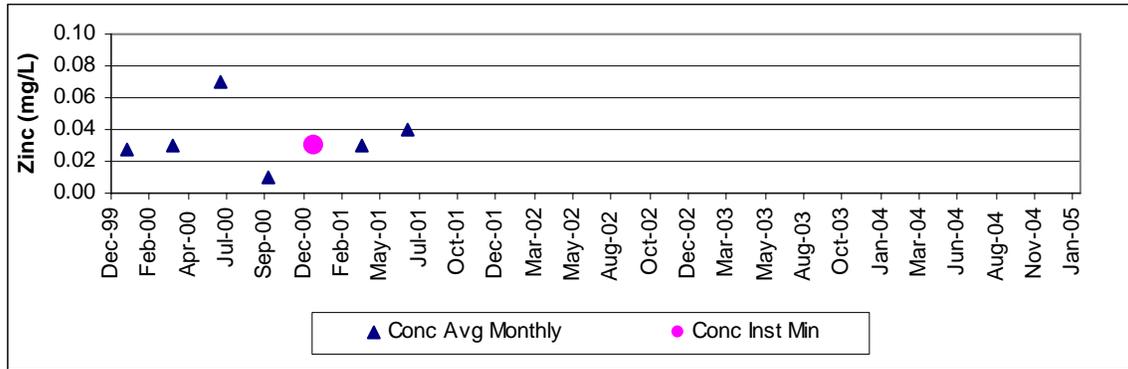


Figure B.130: Laurel Pipe Line Company Outfall 001 Silver Concentration

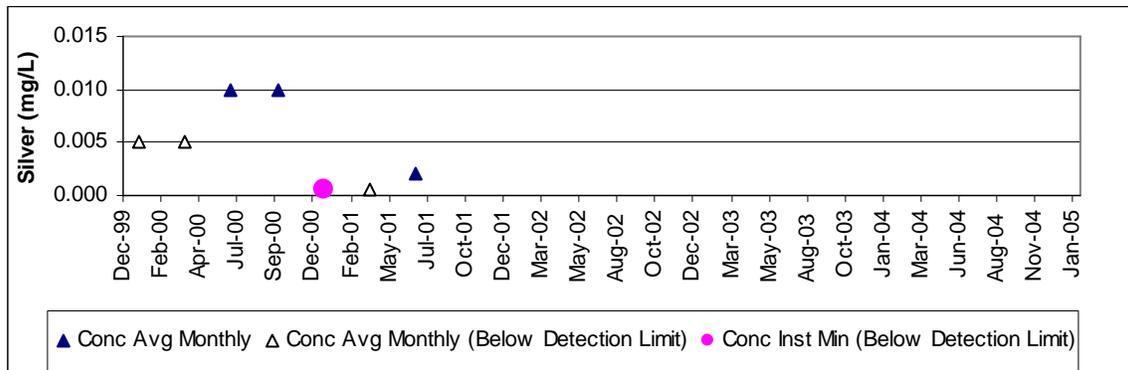


Figure B.131: Laurel Pipe Line Company Outfall 001 TRC Concentration

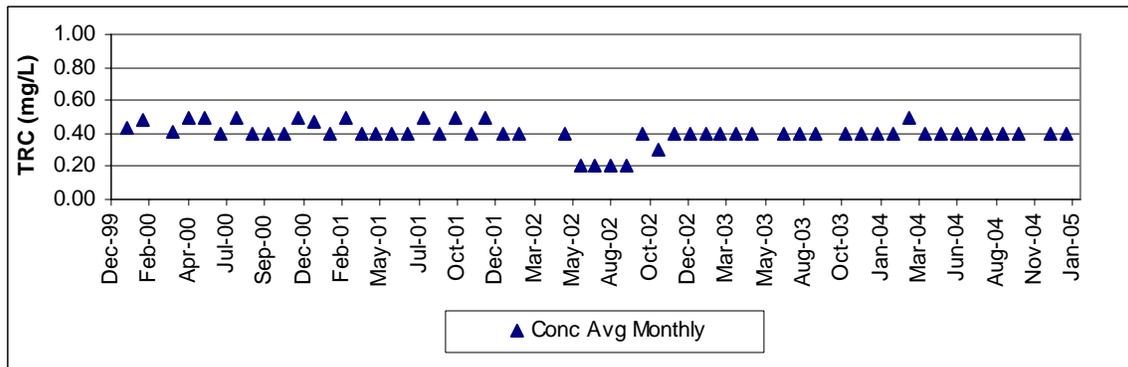


Figure B.132: Garnet Valley HS STP Flow Quantity

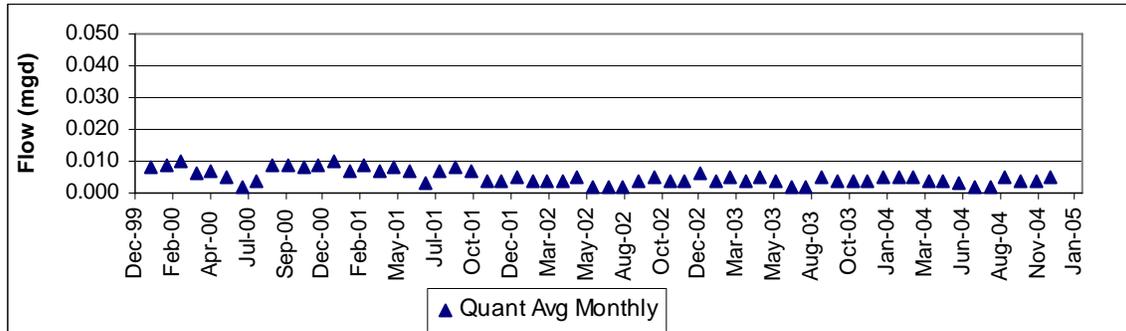


Figure B.133: Garnet Valley HS STP CBOD5 Quantity

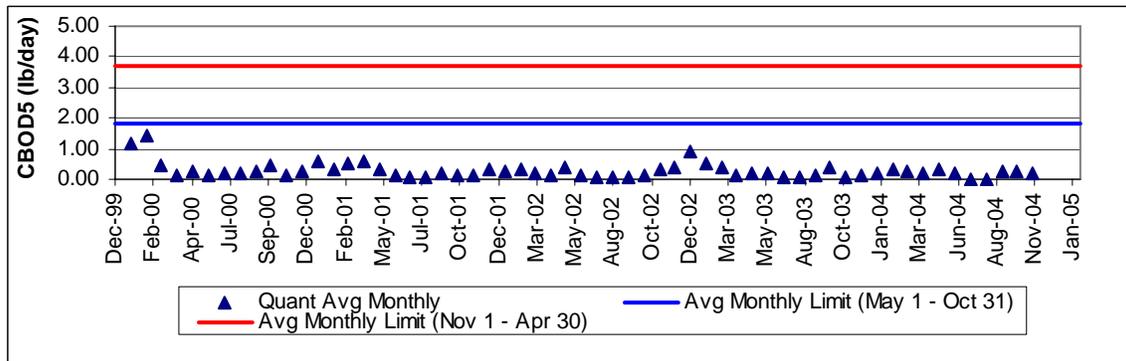


Figure B.134: Garnet Valley HS STP CBOD5 Concentration

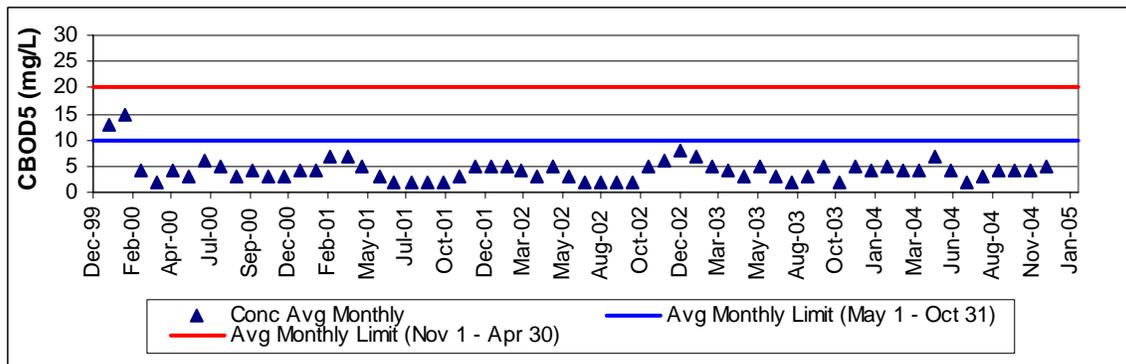


Figure B.135: Garnet Valley HS STP pH Concentration

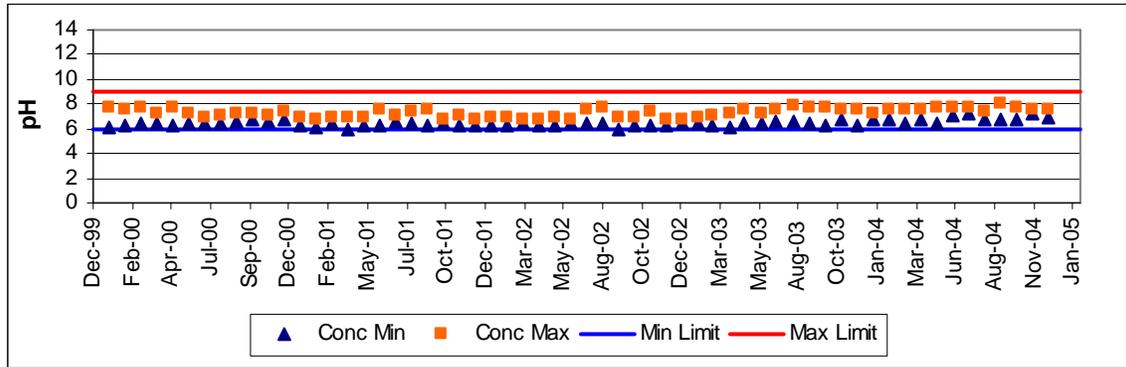


Figure B.136: Garnet Valley HS STP TSS Quantity

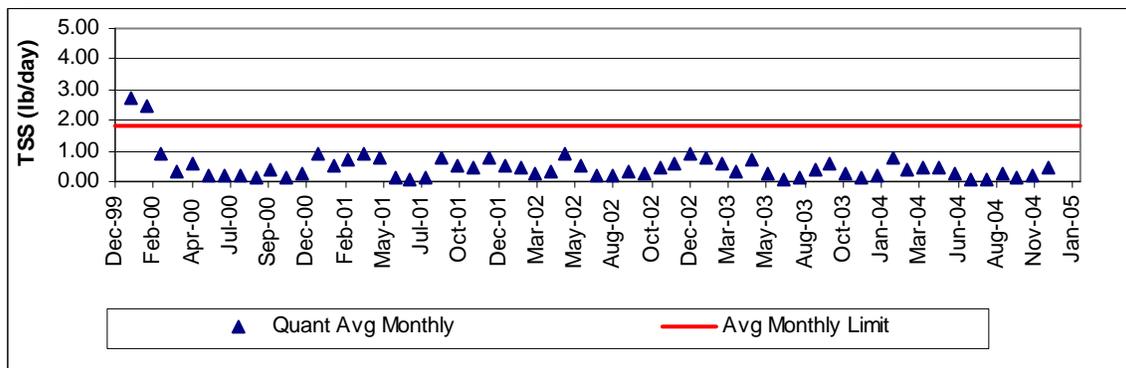


Figure B.137: Garnet Valley HS STP TSS Concentration

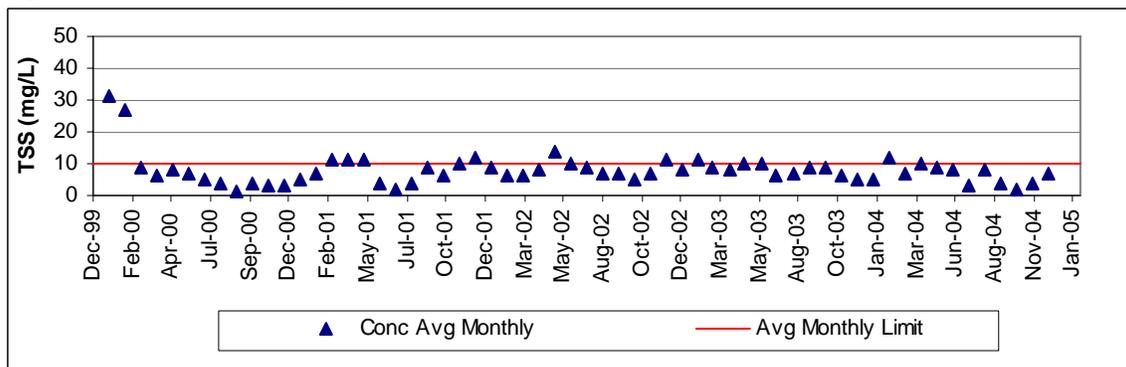


Figure B.138: Garnet Valley HS STP Dissolved Oxygen Concentration

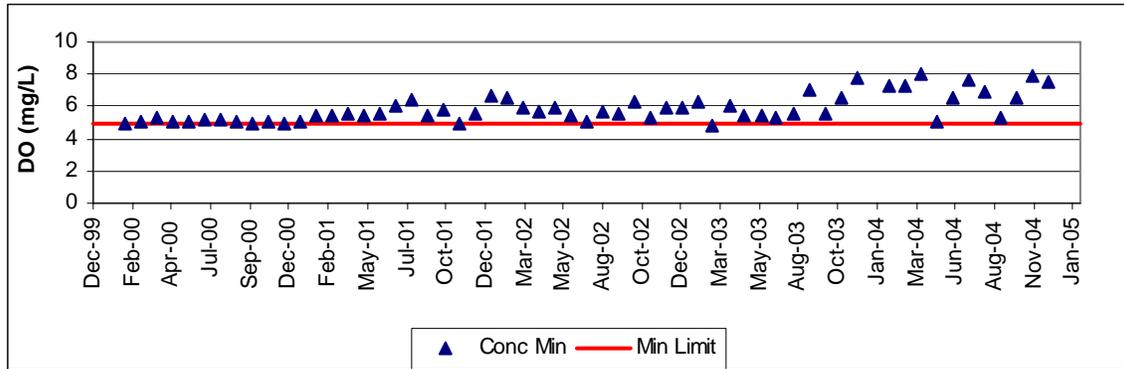


Figure B.139: Garnet Valley HS STP Ammonia Quantity

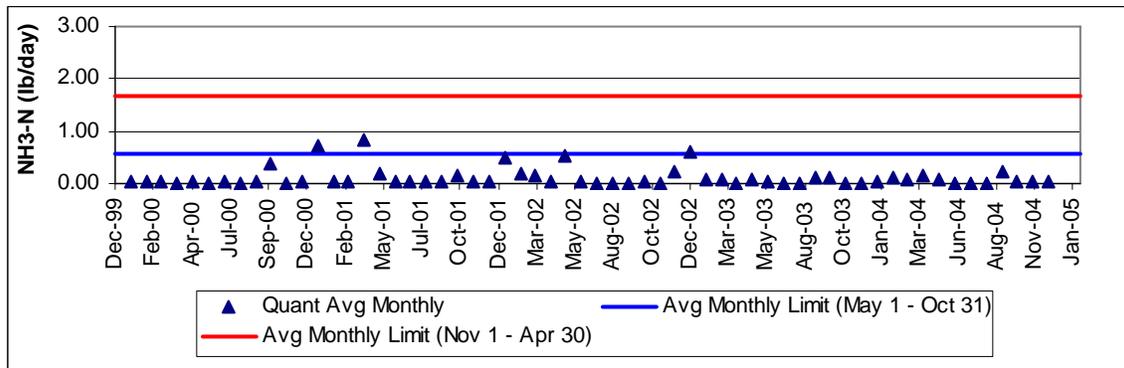


Figure B.140: Garnet Valley HS STP Ammonia Concentration

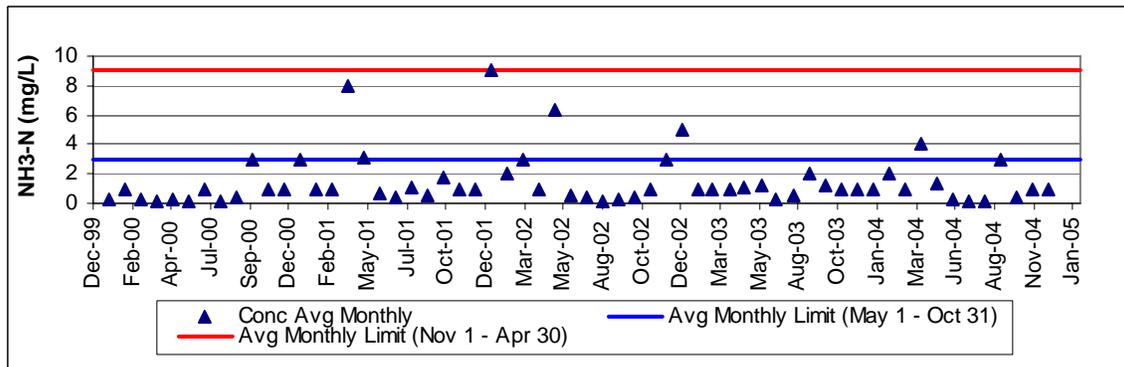


Figure B.141: Garnet Valley HS STP Fecal Coliform Concentration

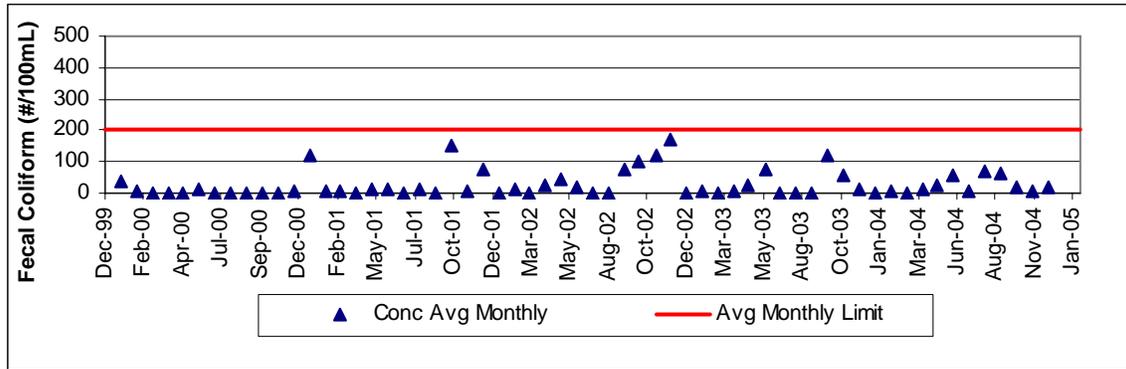


Figure B.142: Garnet Valley HS STP TRC Concentration

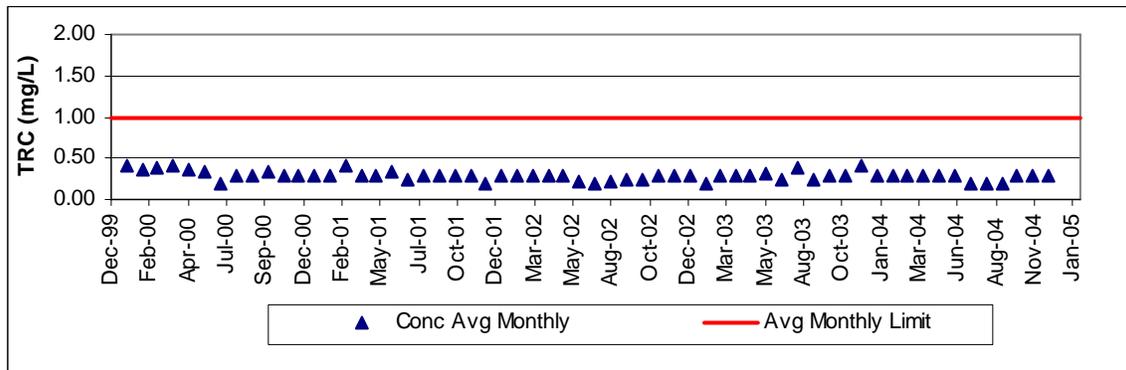


Figure B.143: Rivera at Concord STP Flow Quantity

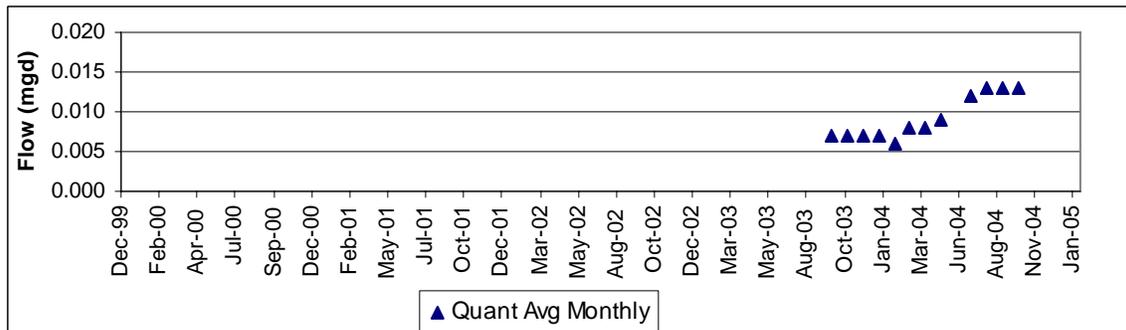


Figure B.144: Rivera at Concord STP CBOD5 Concentration

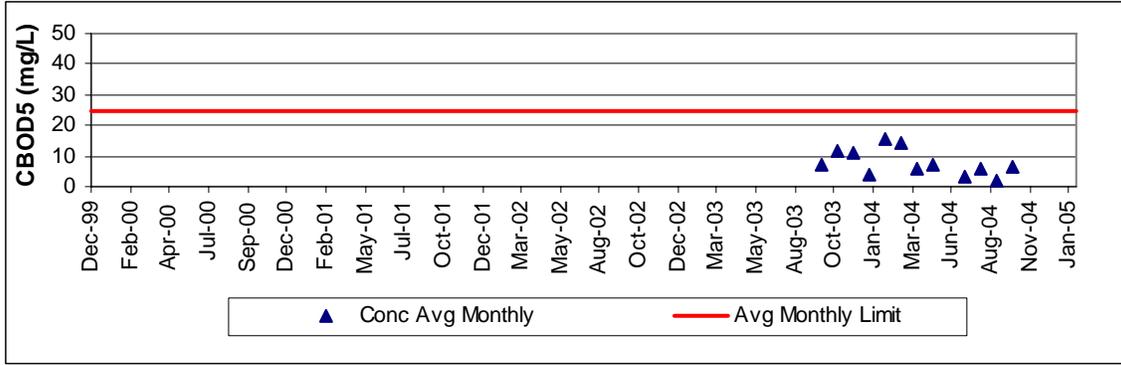


Figure B.145: Rivera at Concord STP pH Concentration

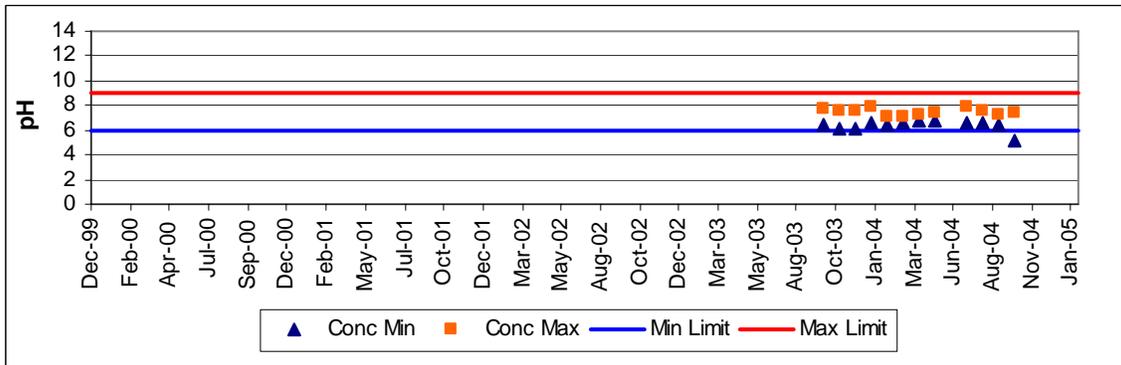


Figure B.146: Rivera at Concord STP TSS Concentration

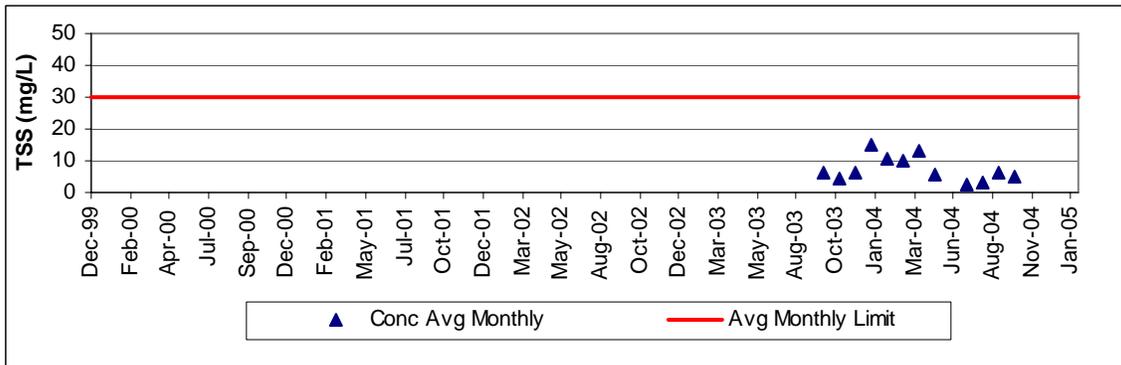


Figure B.147: Rivera at Concord STP Dissolved Oxygen Concentration

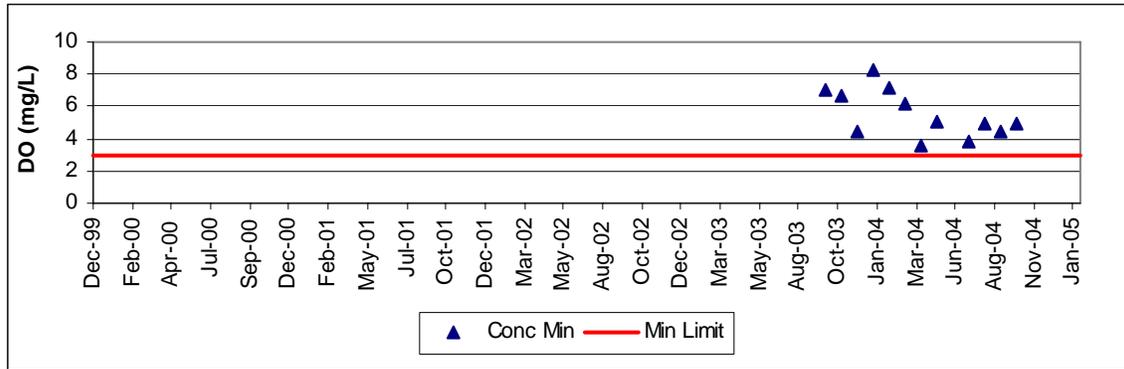


Figure B.148: Rivera at Concord STP Ammonia Concentration

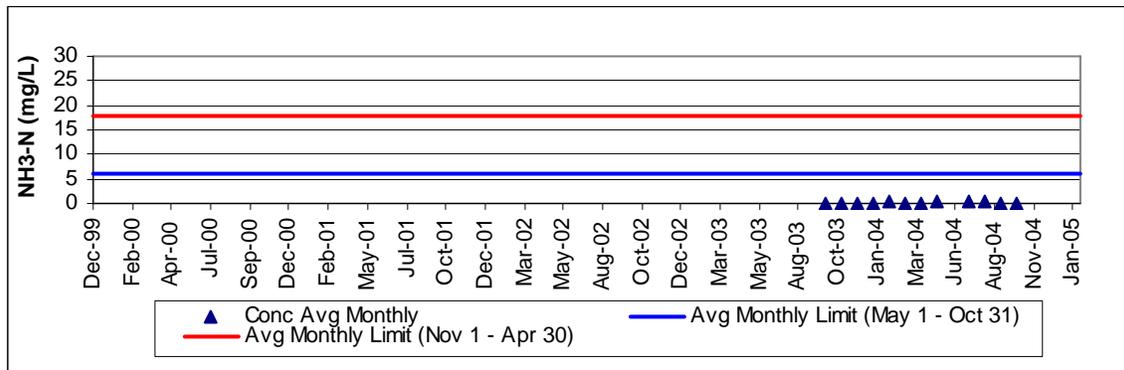


Figure B.149: Rivera at Concord STP Fecal Coliform Concentration

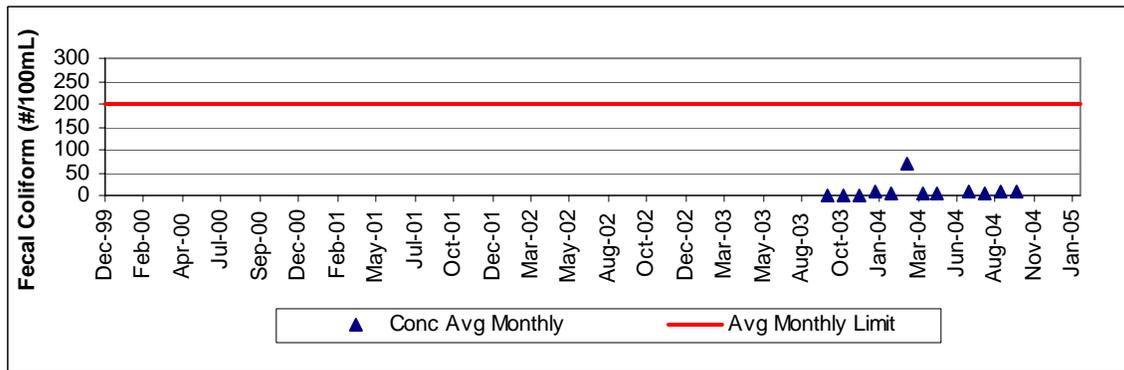


Figure B.150: Coventry Crossing Apartments STP Flow Quantity

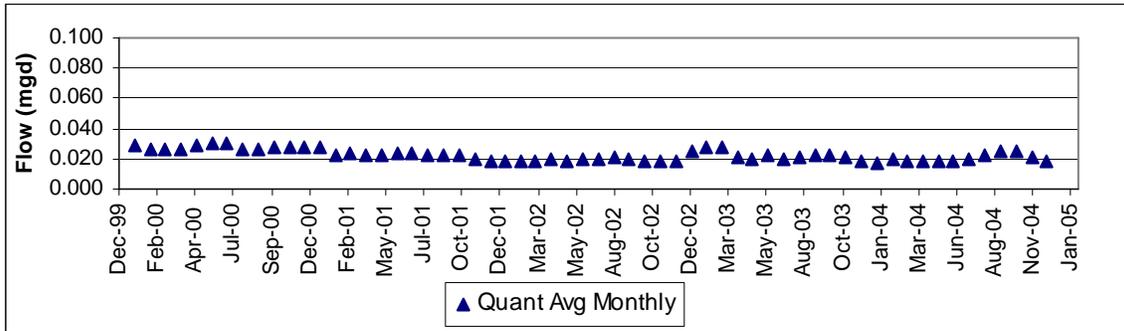


Figure B.151: Coventry Crossing Apartments STP CBOD5 Quantity

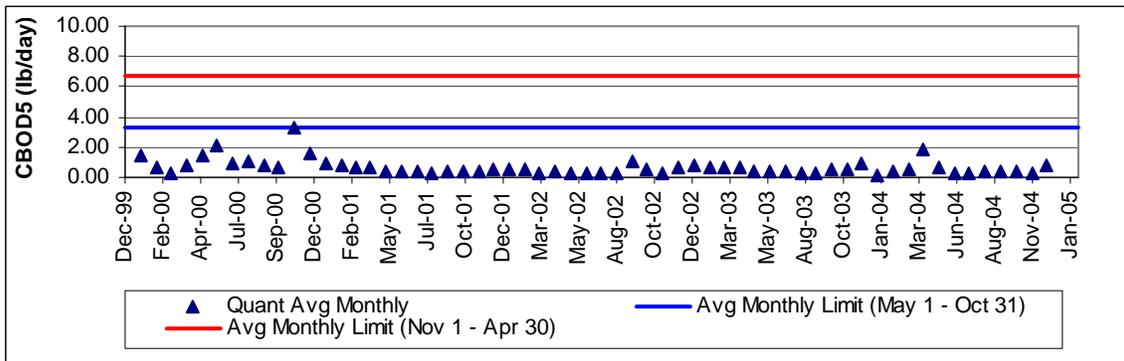


Figure B.152: Coventry Crossing Apartments STP CBOD5 Concentration

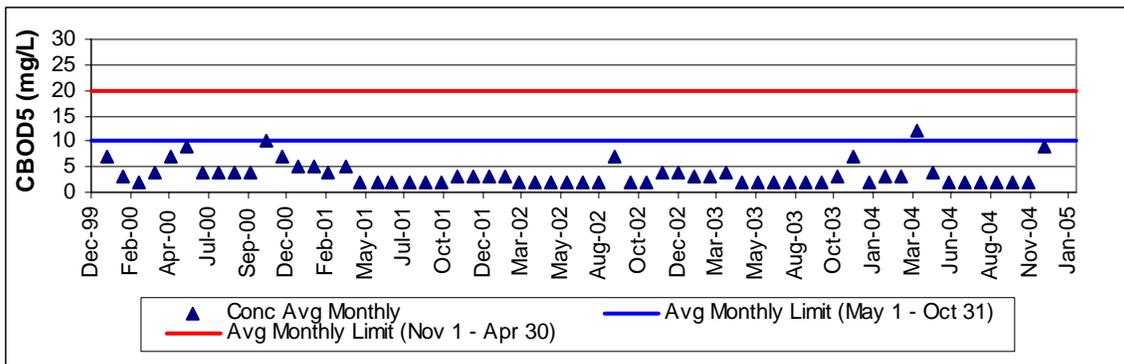


Figure B.153: Coventry Crossing Apartments STP pH Concentration

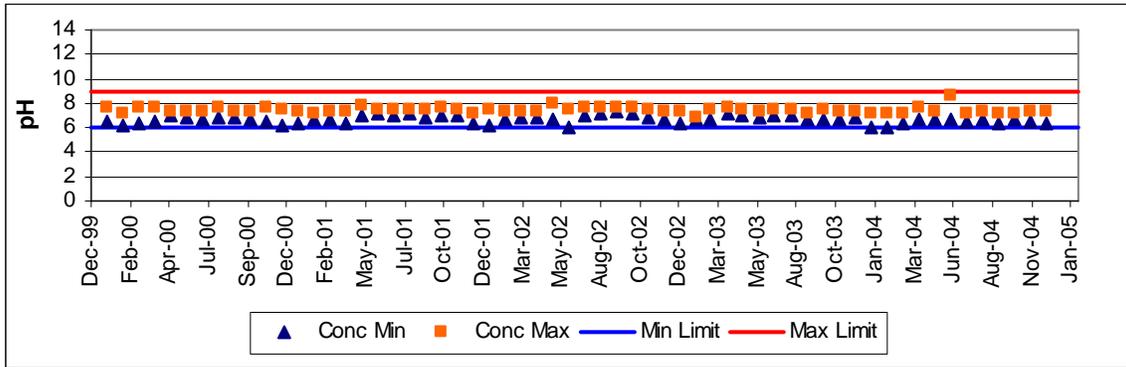


Figure B.154: Coventry Crossing Apartments STP TSS Quantity

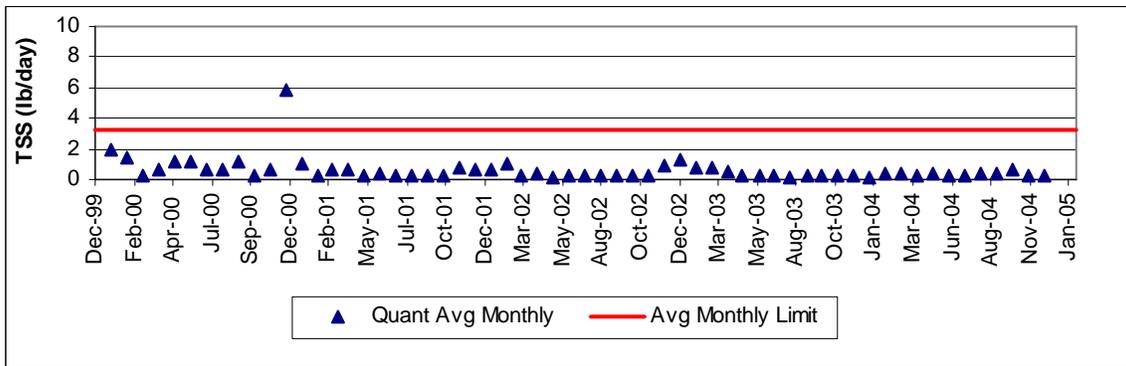


Figure B.155: Coventry Crossing Apartments STP TSS Concentration

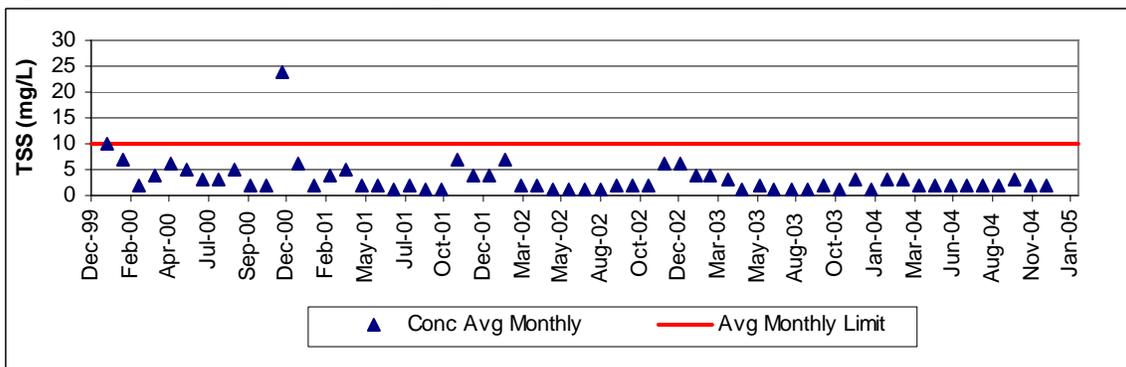


Figure B.156: Coventry Crossing Apartments STP Dissolved Oxygen Concentration

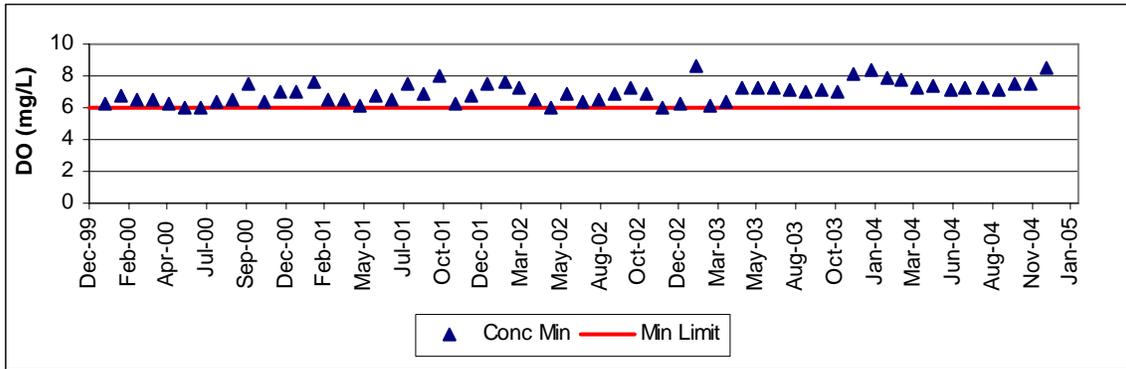


Figure B.157: Coventry Crossing Apartments STP Ammonia Quantity

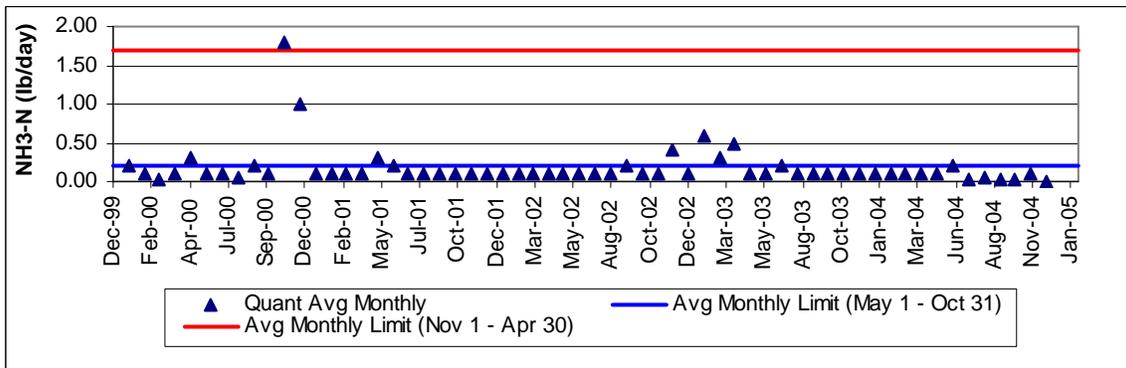


Figure B.158: Coventry Crossing Apartments STP Ammonia Concentration

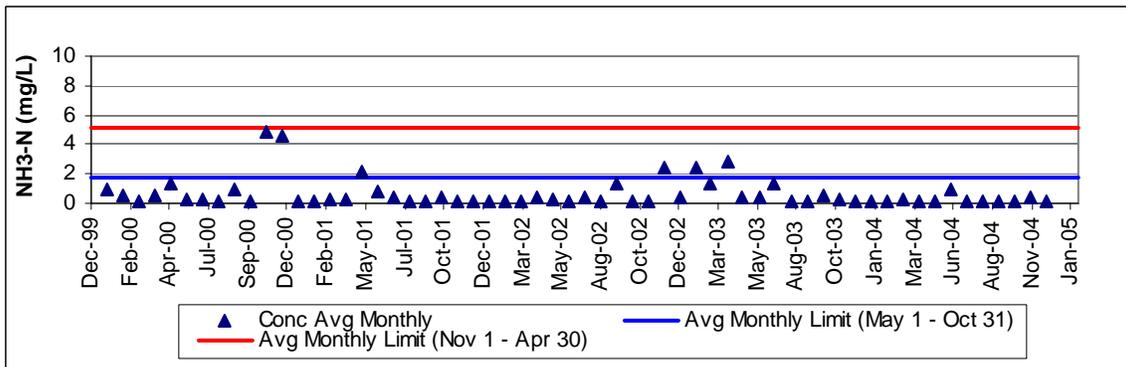


Figure B.159: Coventry Crossing Apartments STP Fecal Coliform Concentration

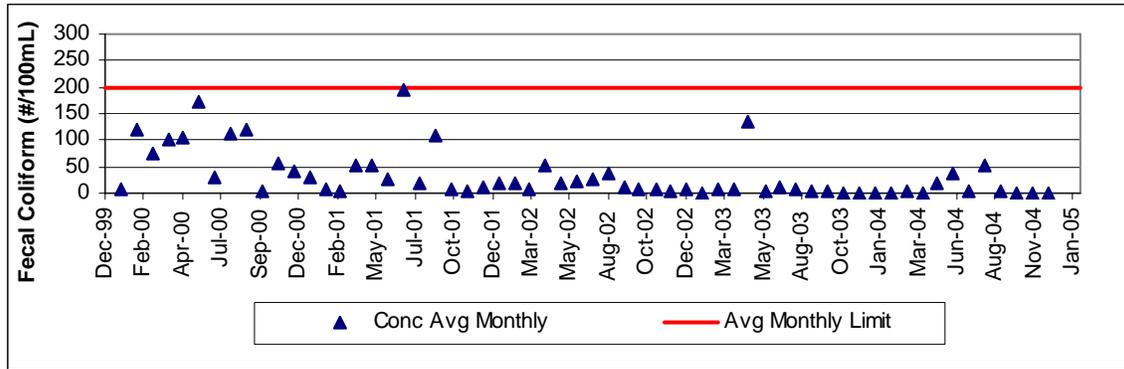


Figure B.160: Coventry Crossing Apartments STP TRC Concentration

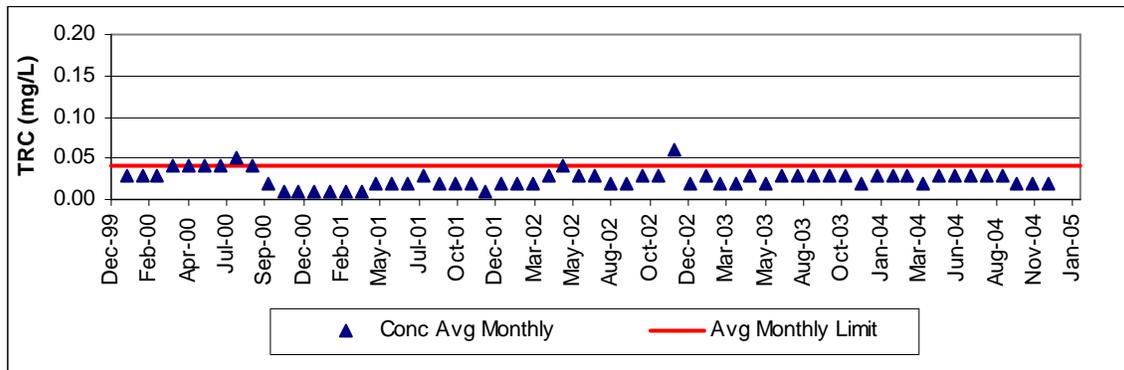


Figure B.161: Concordville Hotel STP Flow Quantity

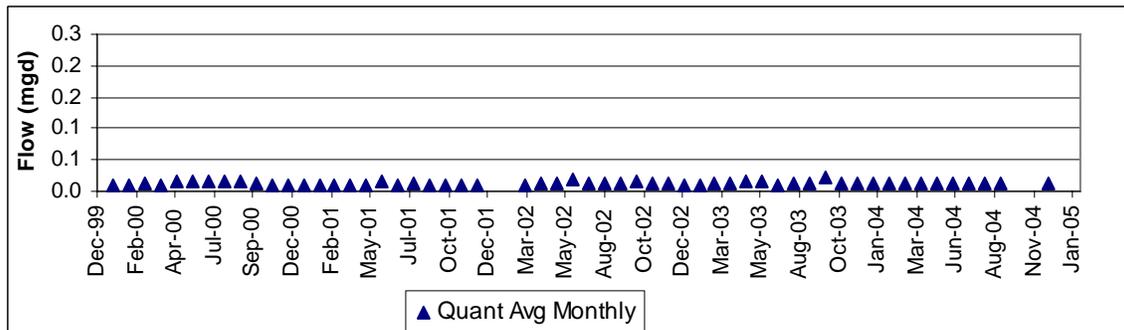


Figure B.162: Concordville Hotel STP CBOD5 Quantity

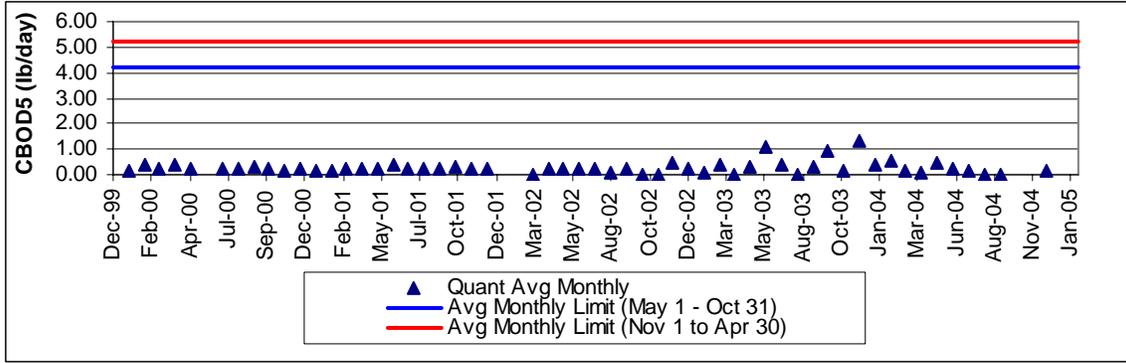


Figure B.163: Concordville Hotel STP CBOD5 Concentration

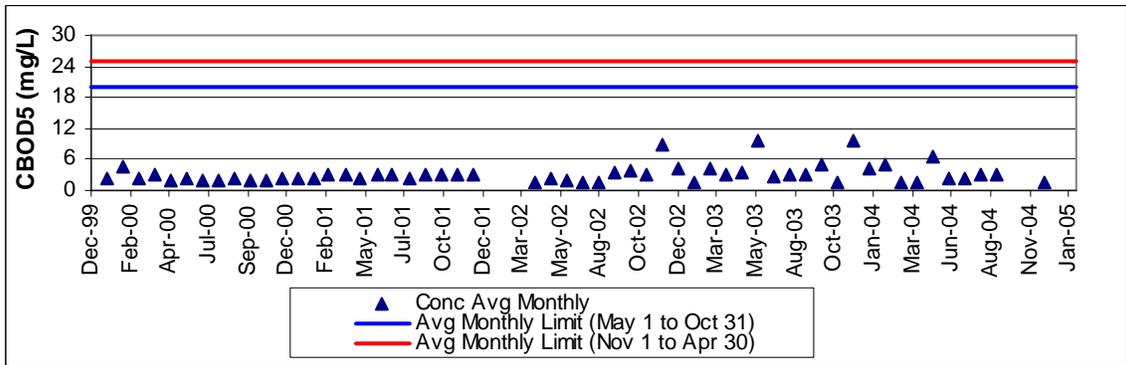


Figure B.164: Concordville Hotel STP pH Concentration

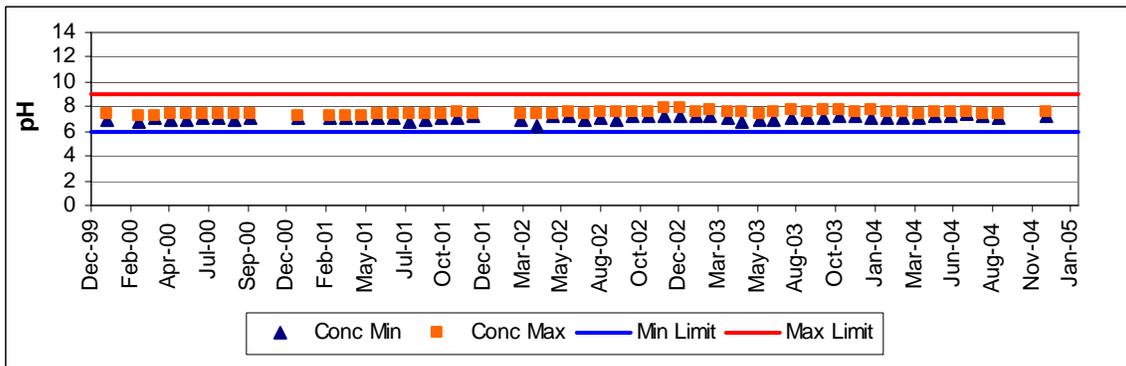


Figure B.165: Concordville Hotel STP TSS Quantity

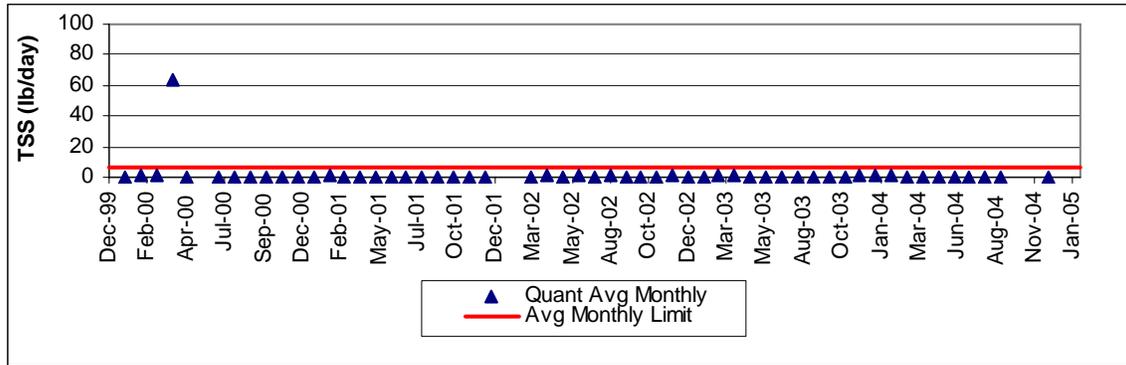


Figure B.166: Concordville Hotel STP TSS Concentration

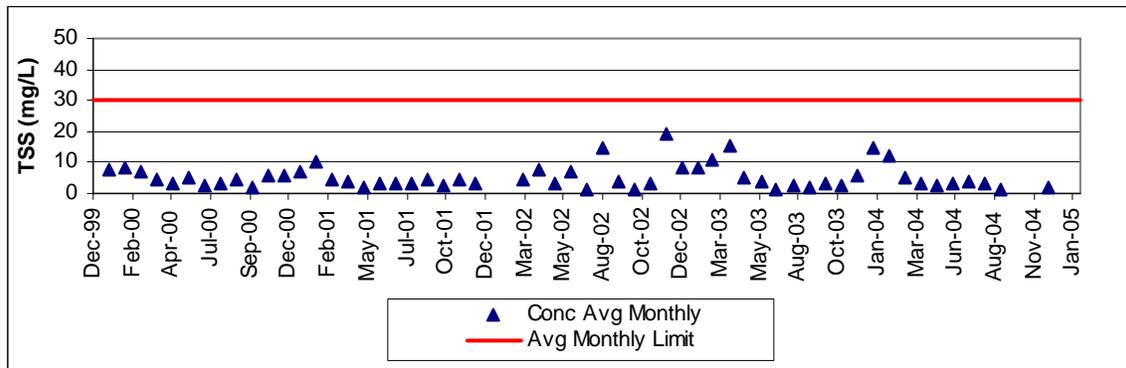


Figure B.167: Concordville Hotel STP Dissolved Oxygen Concentration

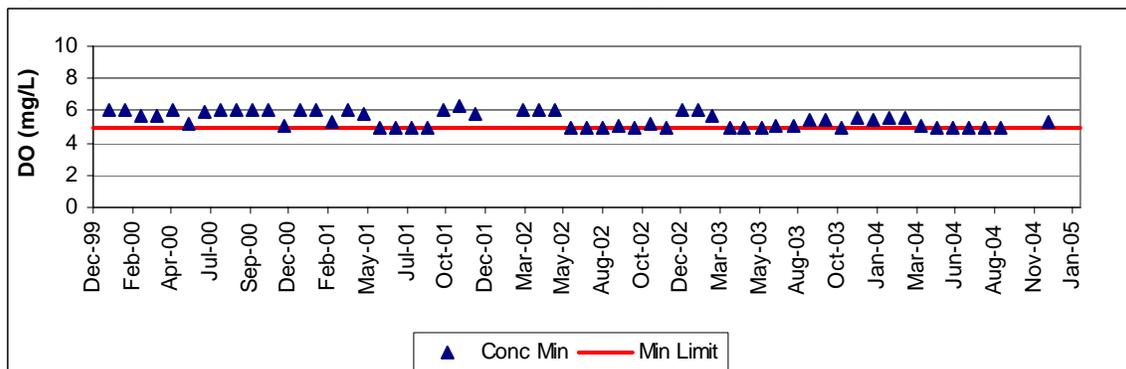


Figure B.168: Concordville Hotel STP Ammonia Quantity

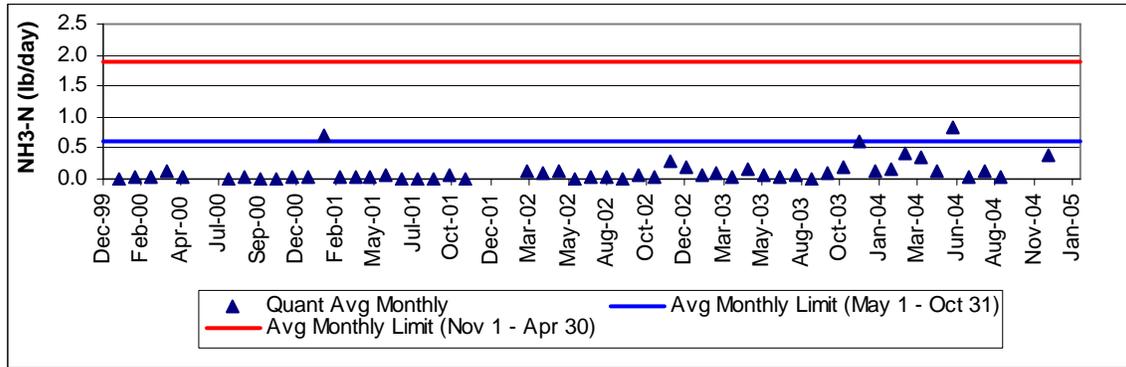


Figure B.169: Concordville Hotel STP Ammonia Concentration

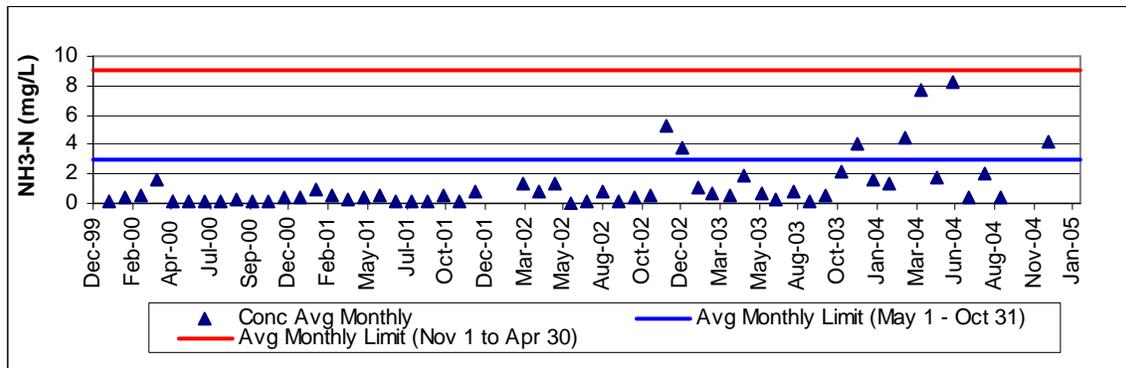


Figure B.170: Concordville Hotel STP Fecal Coliform Concentration

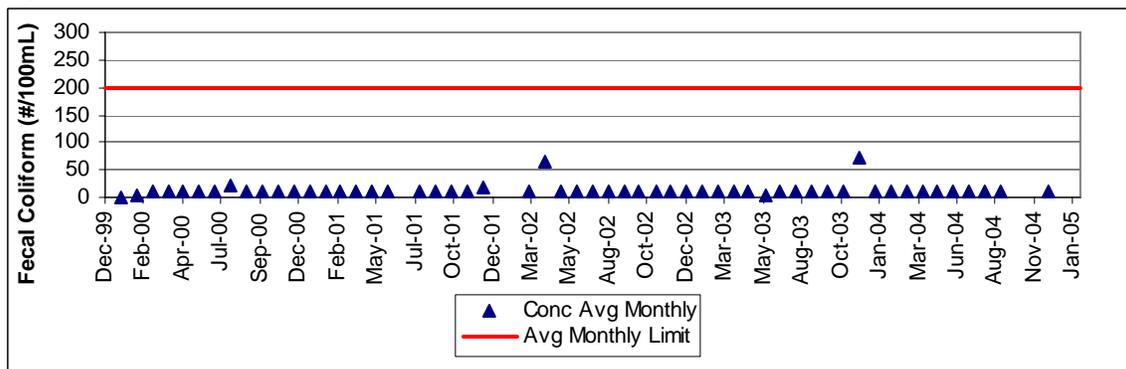


Figure B.171: Concordville Hotel STP TRC Concentration

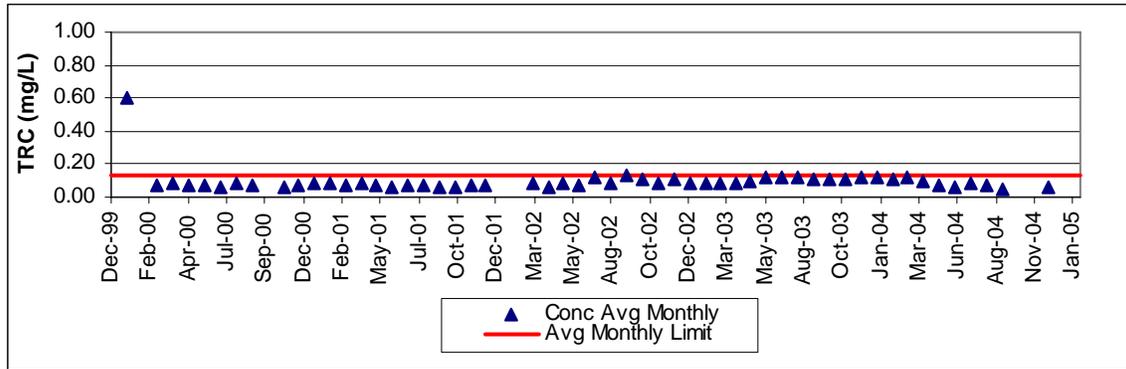


Figure B.172: Concord Country Club Flow Quantity

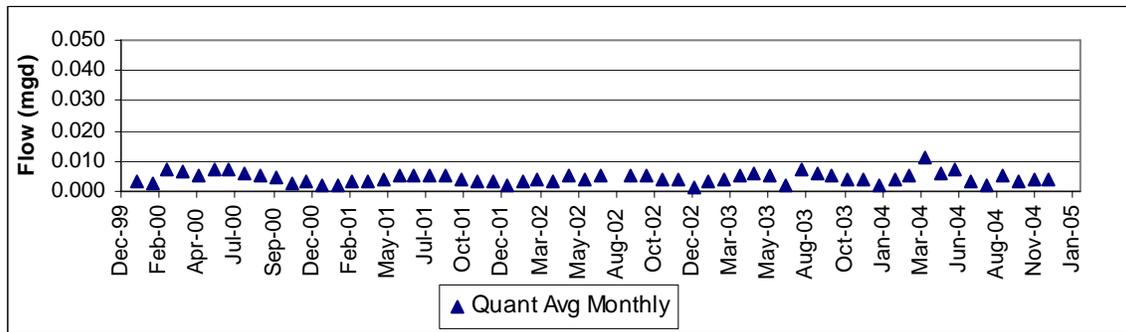


Figure B.173: Concord Country Club CBOD5 Concentration

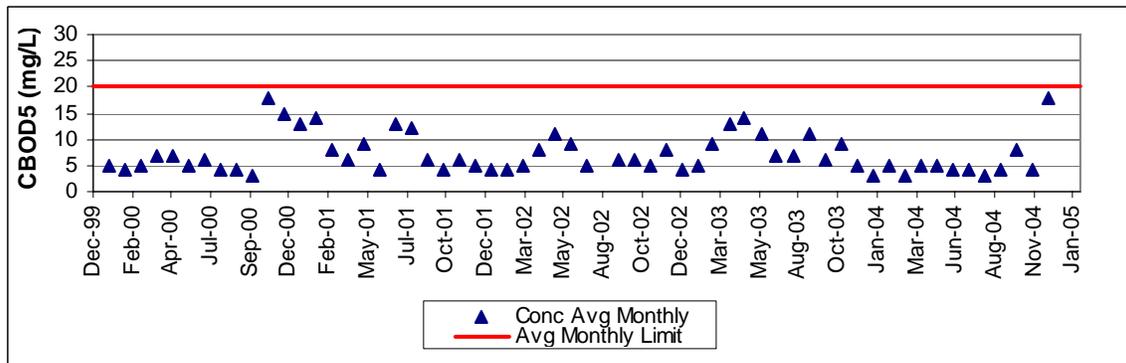


Figure B.174: Concord Country Club pH Concentration

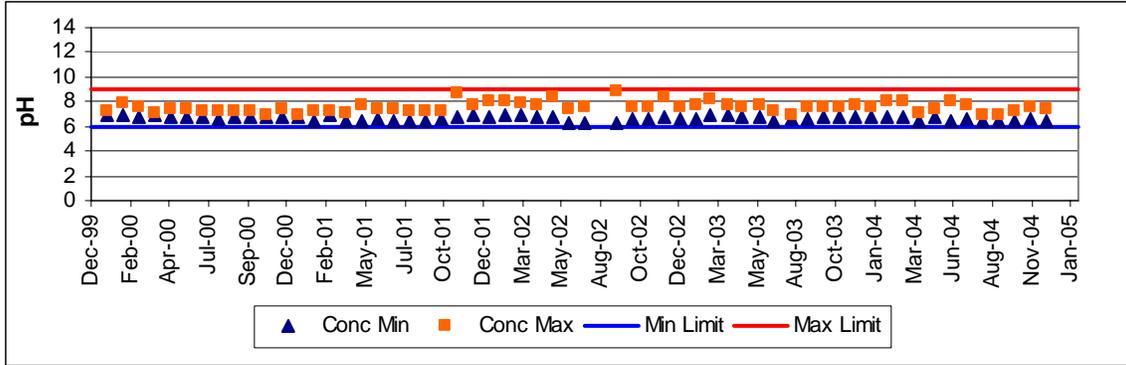


Figure B.175: Concord Country Club TSS Concentration

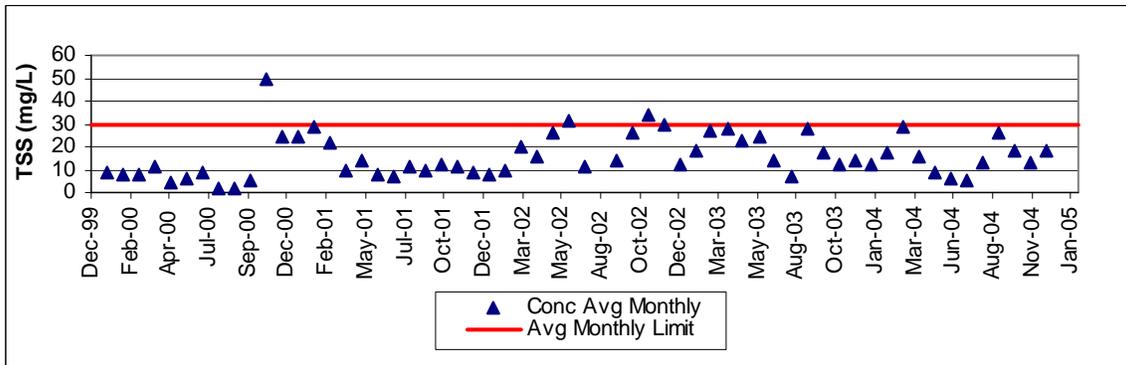


Figure B.176: Concord Country Club Dissolved Oxygen Concentration

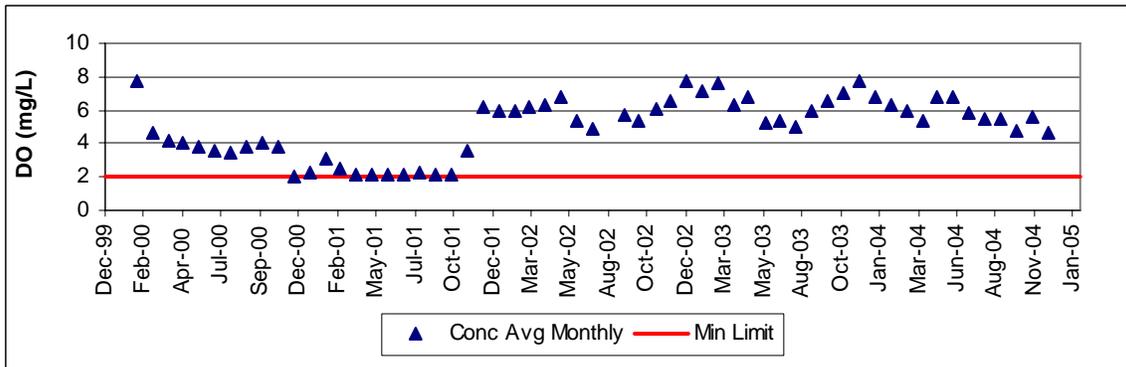


Figure B.177: Concord Country Club Ammonia Concentration

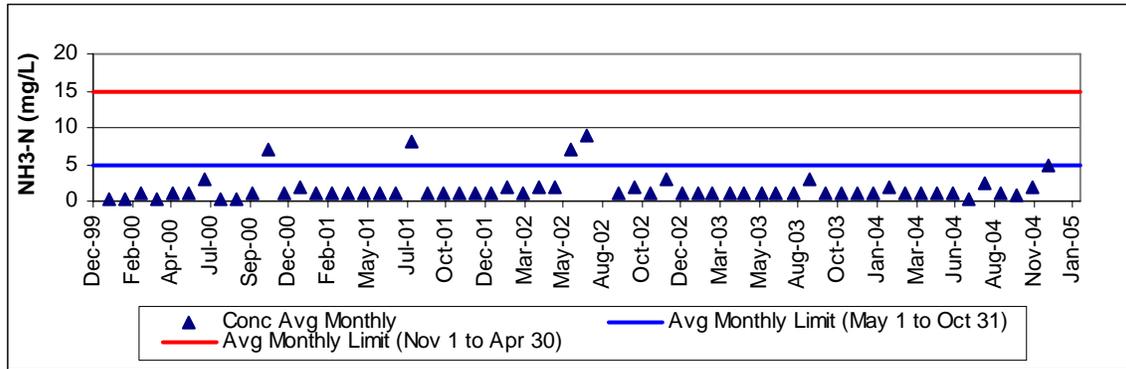


Figure B.178: Concord Country Club Fecal Coliform Concentration

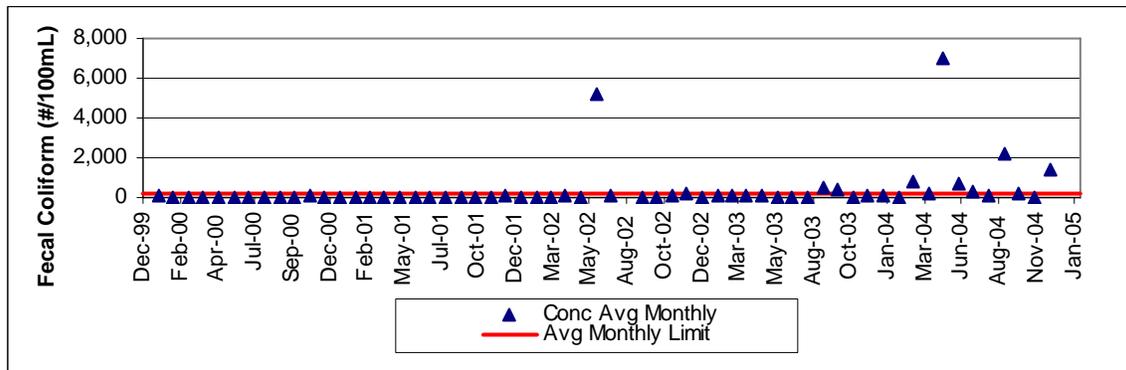


Figure B.179: Concord Country Club TRC Concentration

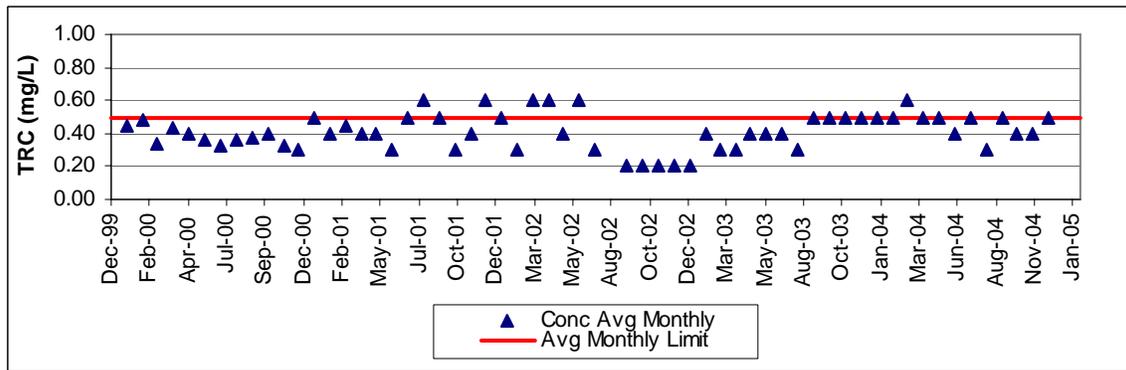


Figure B.180: Southco STP Flow Quantity

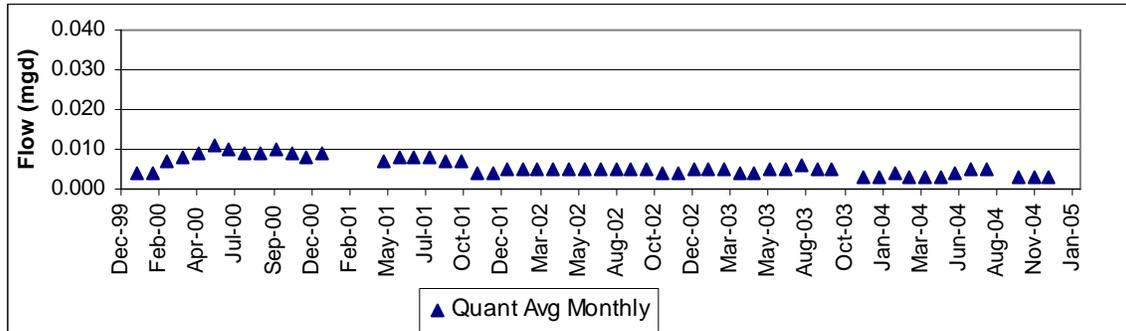


Figure B.181: Southco STP CBOD5 Concentration

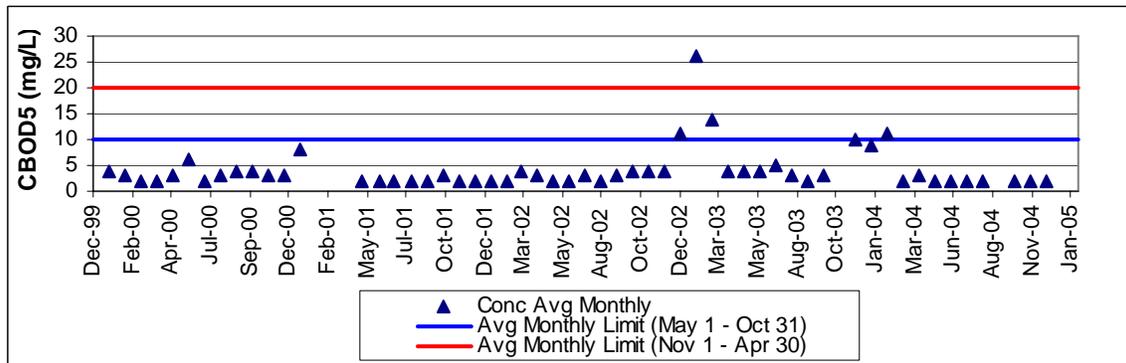


Figure B.182: Southco STP pH Concentration

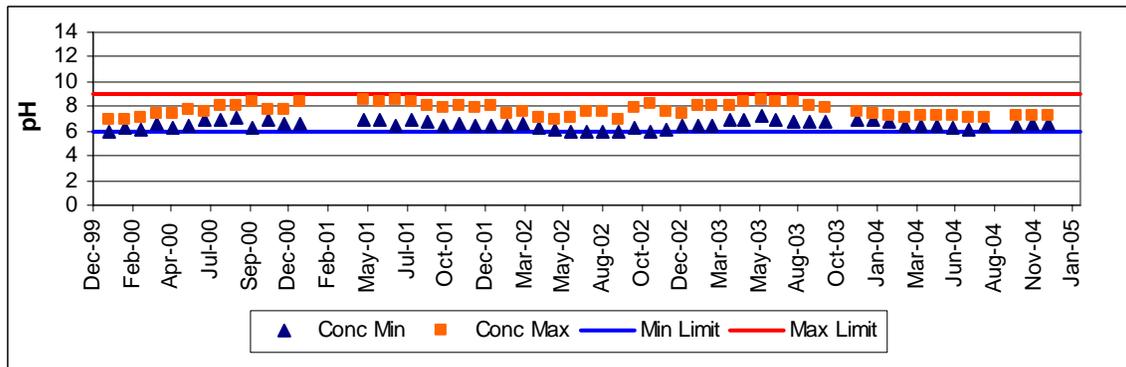


Figure B.183: Southco STP TSS Concentration

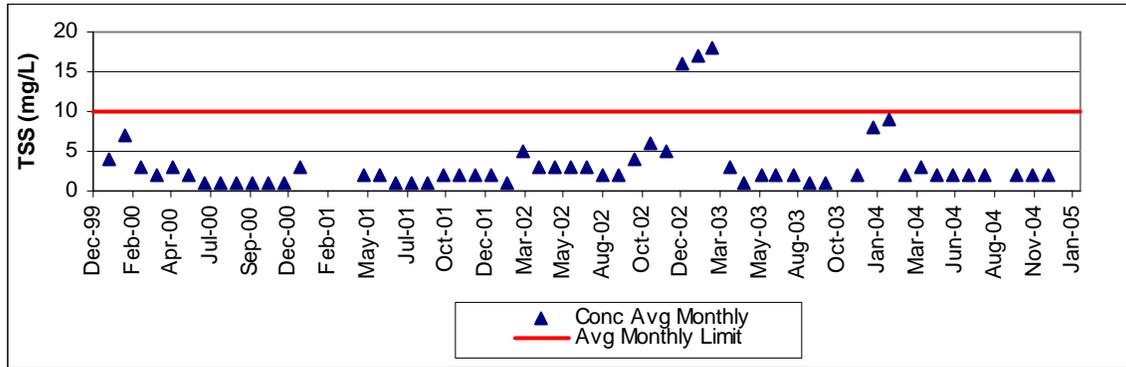


Figure B.184: Southco STP Dissolved Oxygen Concentration

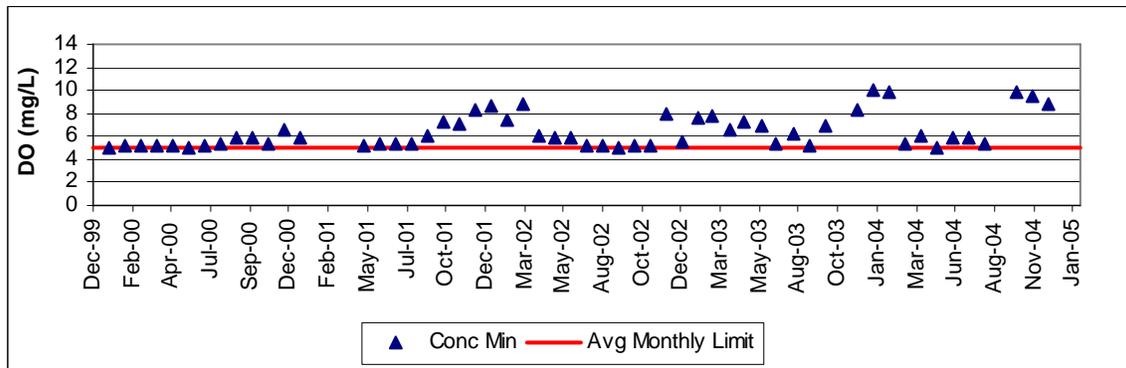


Figure B.185: Southco STP Ammonia Concentration

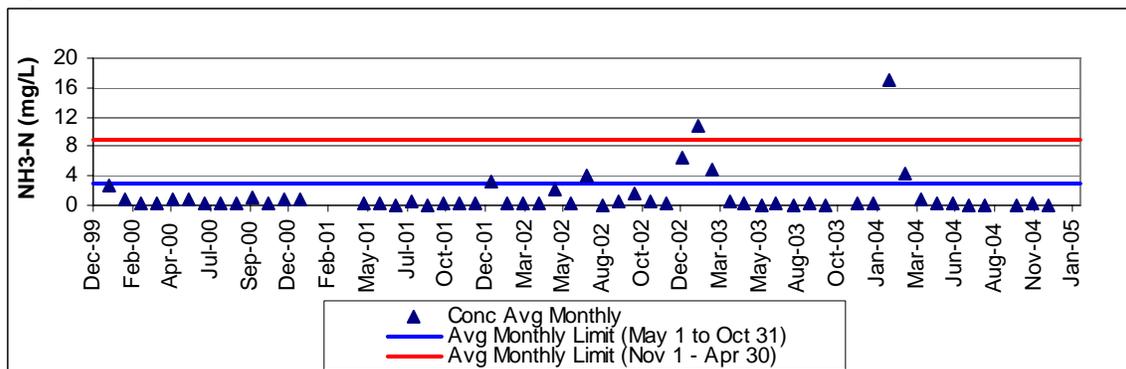


Figure B.186: Southco STP Fecal Coliform Concentration

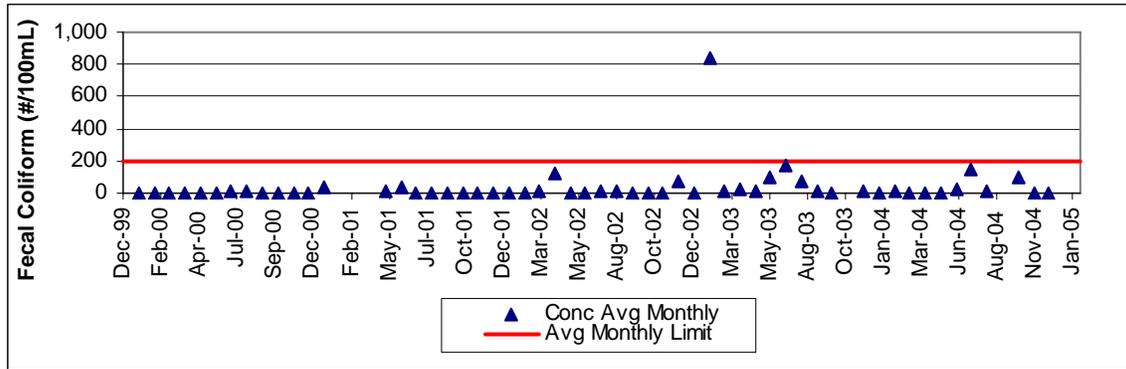


Figure B.187: Southco STP /Weekly TRC Concentration

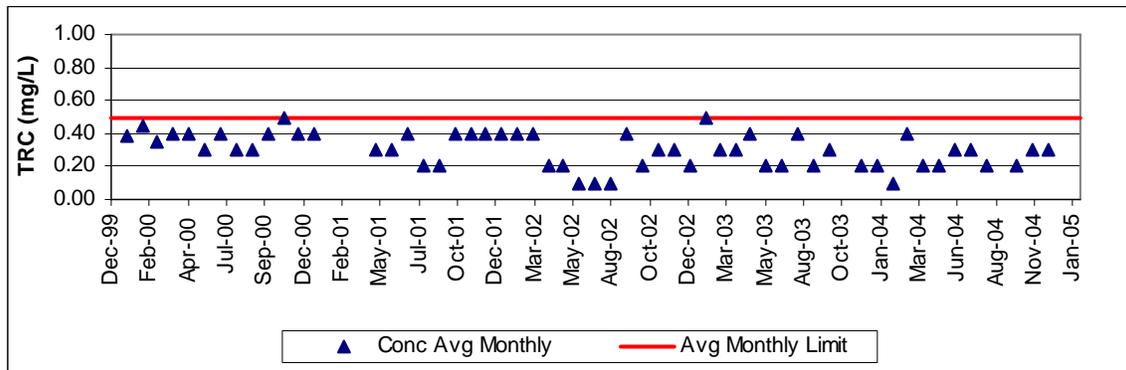


Figure B.188: State Farm Auto Insurance Company STP Flow Quantity

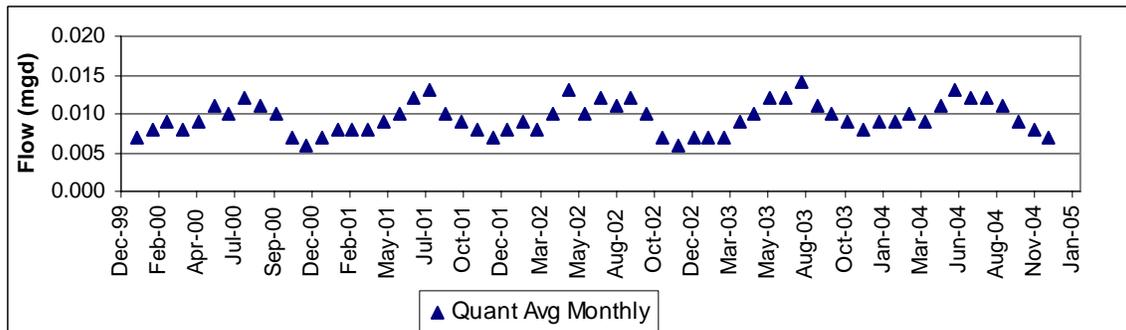


Figure B.189: State Farm Auto Insurance Company STP CBOD5 Concentration

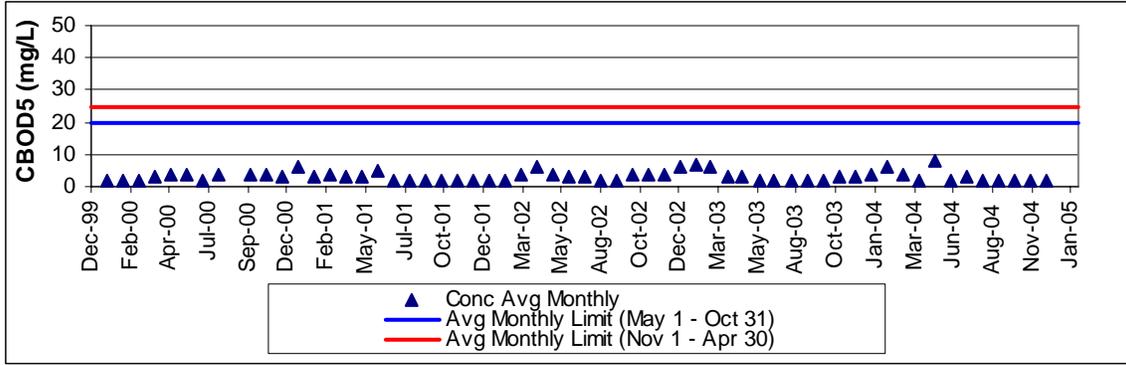


Figure B.190: State Farm Auto Insurance Company STP pH Concentration

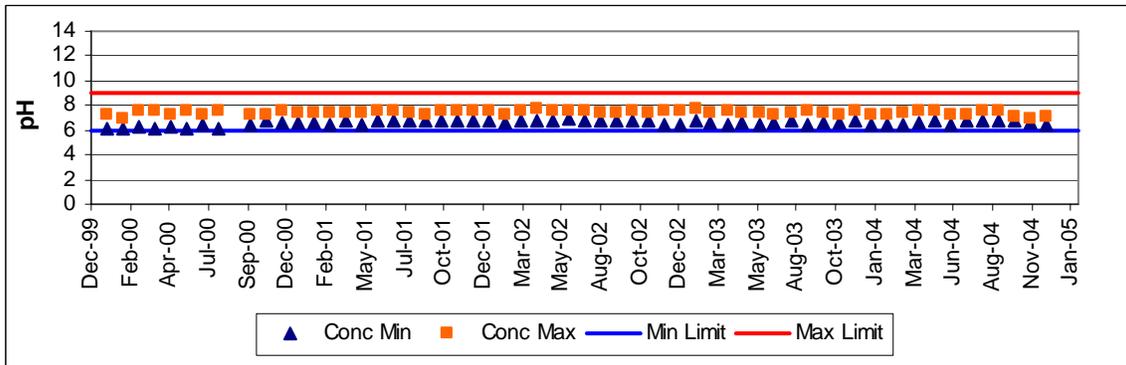


Figure B.191: State Farm Auto Insurance Company STP TSS Concentration

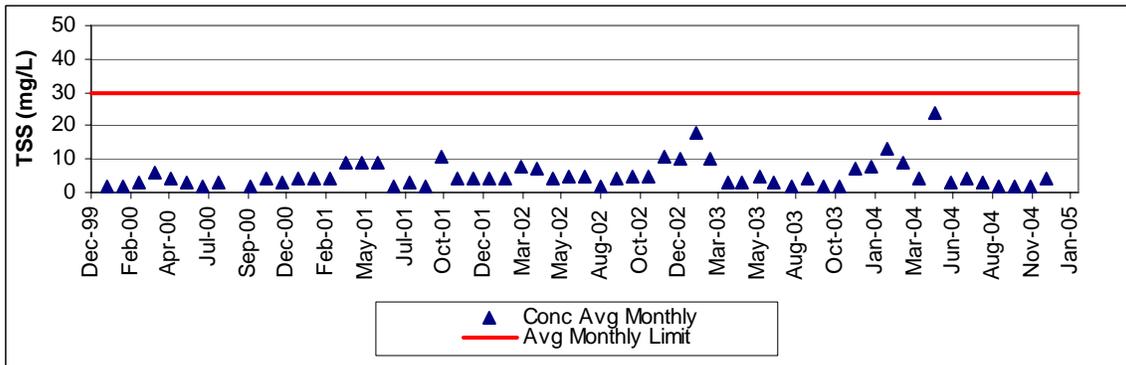


Figure 194 State Farm Auto Insurance Company STP Dissolved Oxygen Concentration

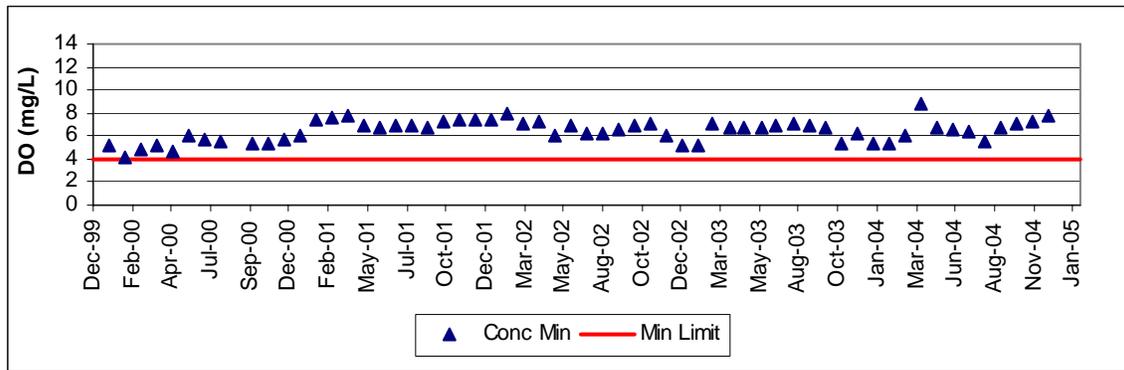


Figure B.192: State Farm Auto Insurance Company STP Ammonia Concentration

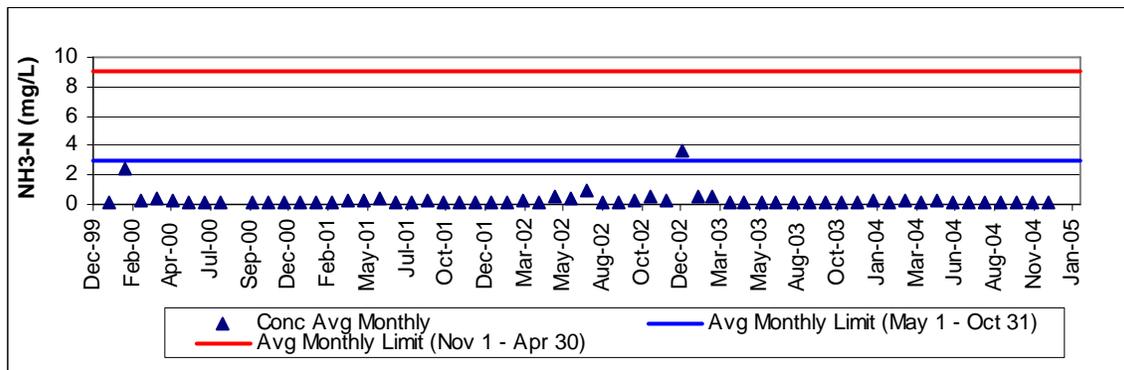


Figure B.193: State Farm Auto Insurance Company STP Fecal Coliform Concentration

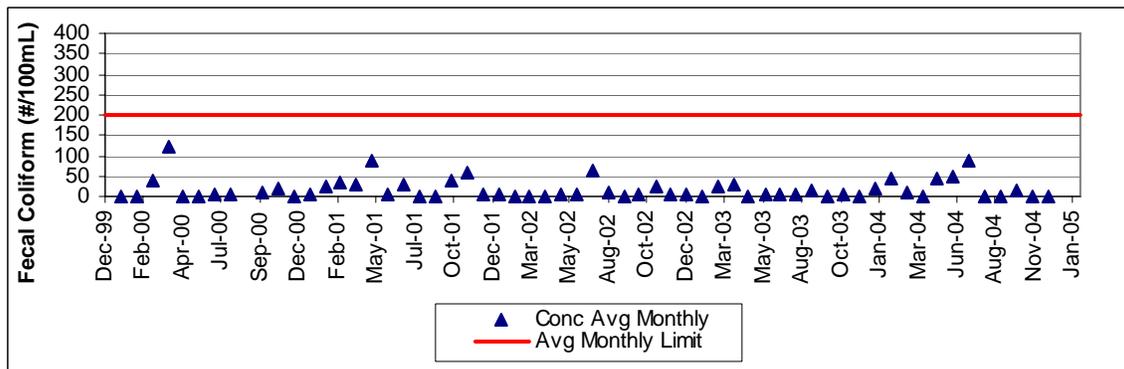


Figure B.194: State Farm Auto Insurance Company STP TRC Concentration

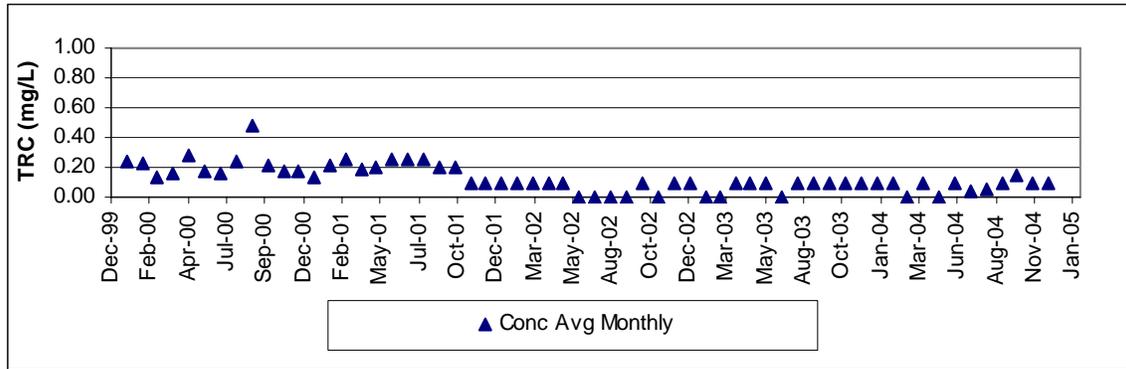


Figure B.195: Springhill Farm STP Flow Quantity

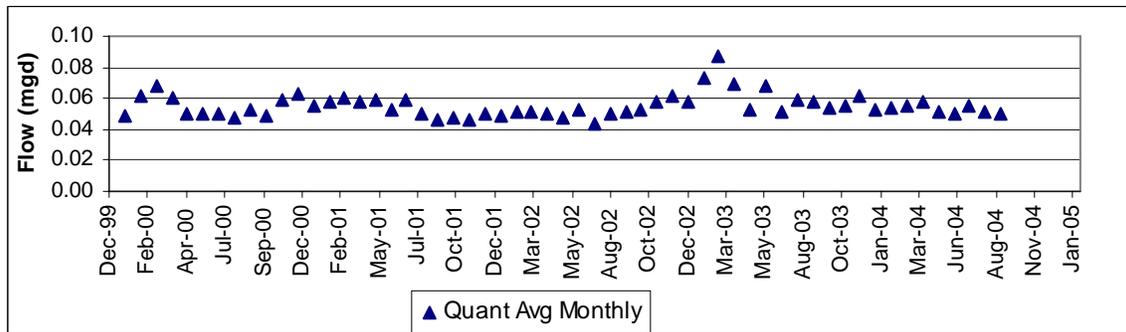


Figure B.196: Springhill Farm STP CBOD5 Quantity

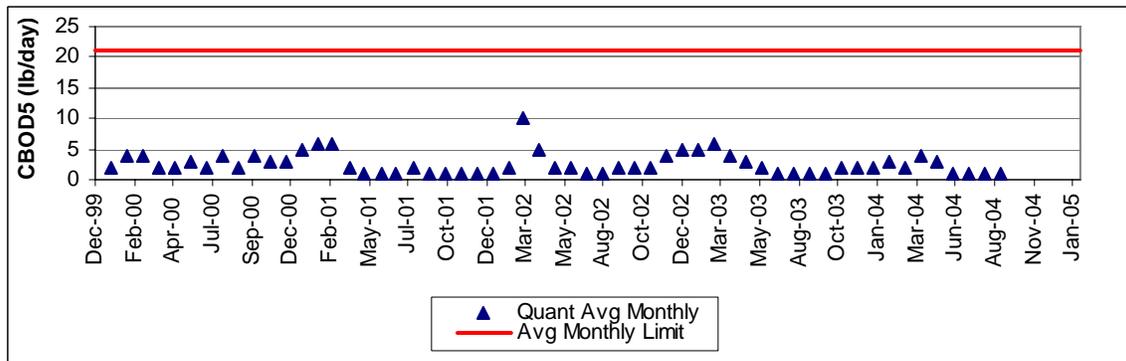


Figure B.197: Springhill Farm STP CBOD5 Concentration

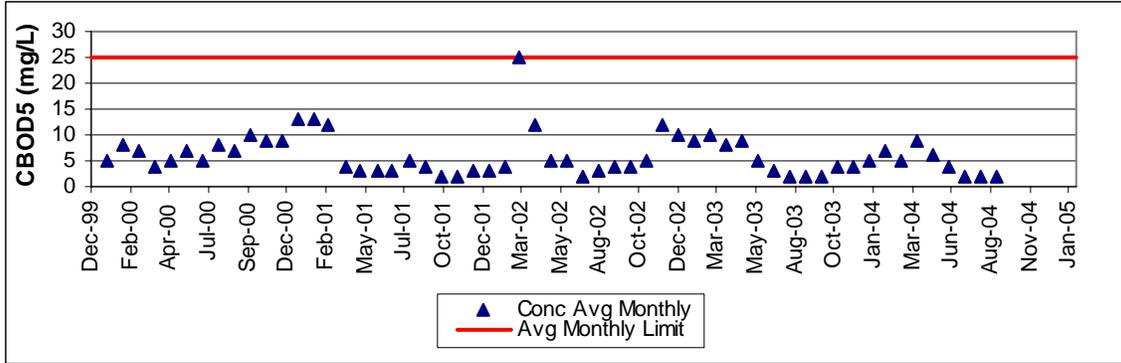


Figure B.198: Springhill Farm STP pH Concentration

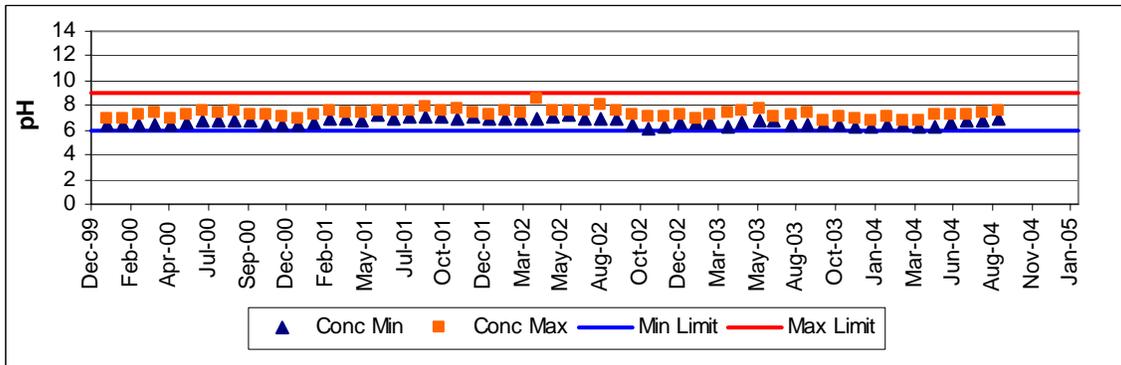


Figure B.199: Springhill Farm STP TSS Quantity

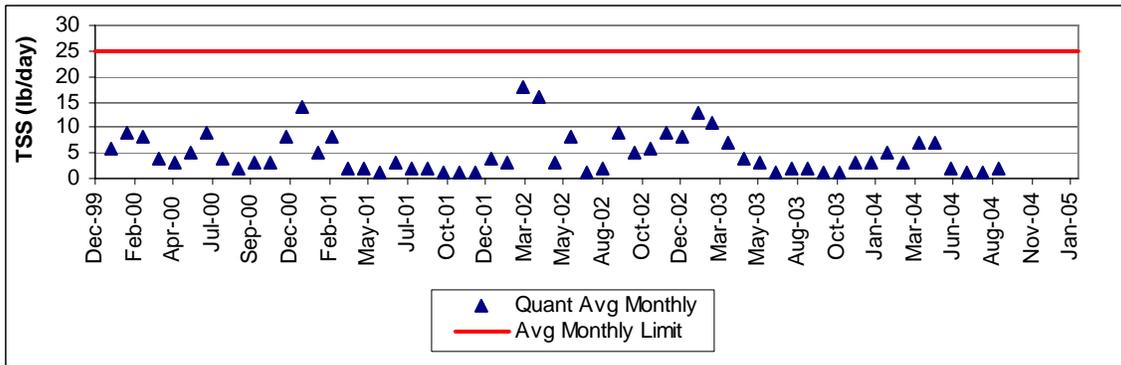


Figure B.200: Springhill Farm STP TSS Concentration

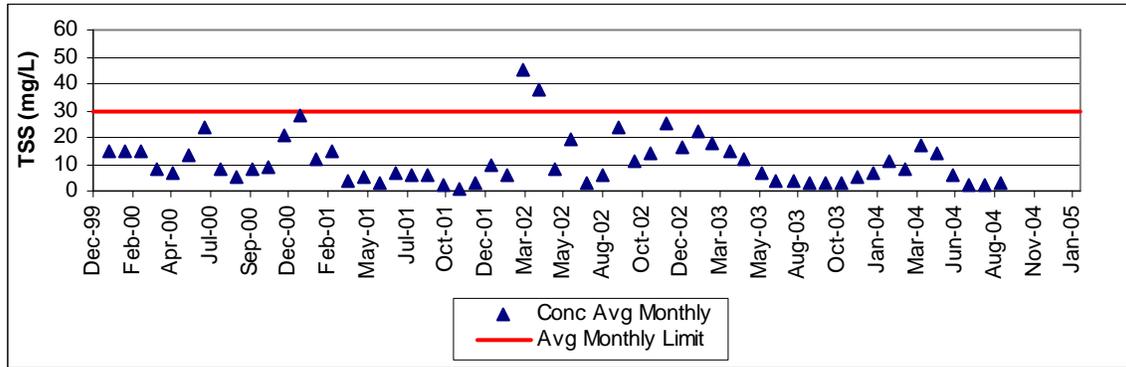


Figure B.201: Springhill Farm STP Dissolved Oxygen Concentration

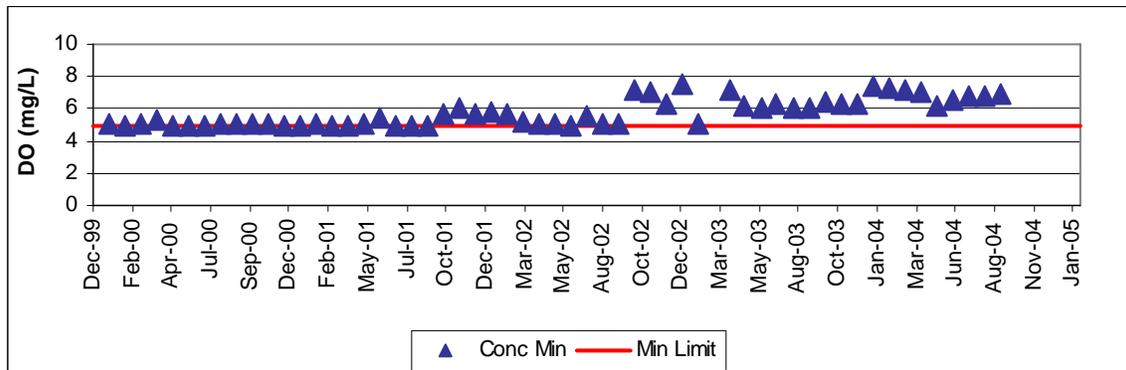


Figure B.202: Springhill Farm STP Ammonia Quantity

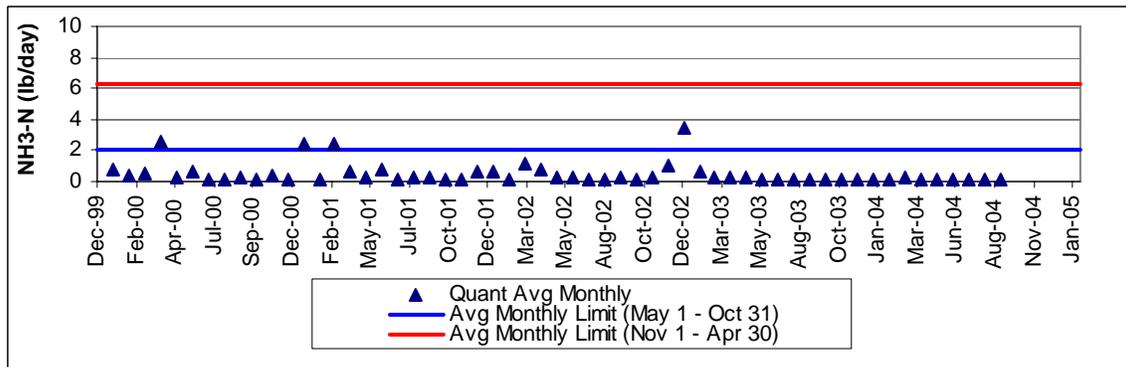


Figure B.203: Springhill Farm STP Ammonia Concentration

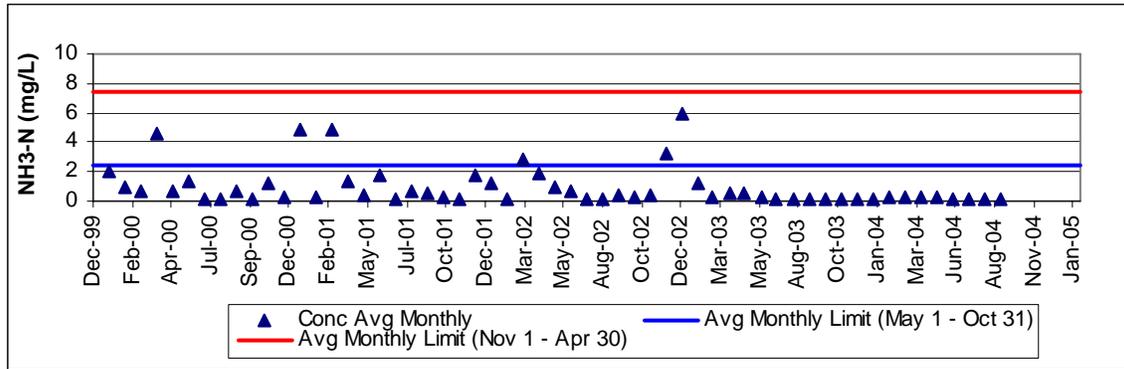


Figure B.204: Springhill Farm STP Fecal Coliform Concentration

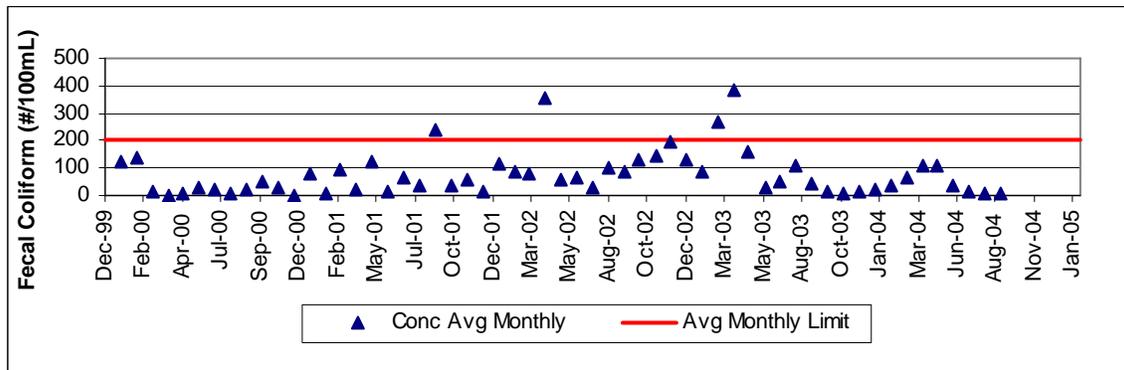


Figure B.205: Springhill Farm STP TRC Concentration

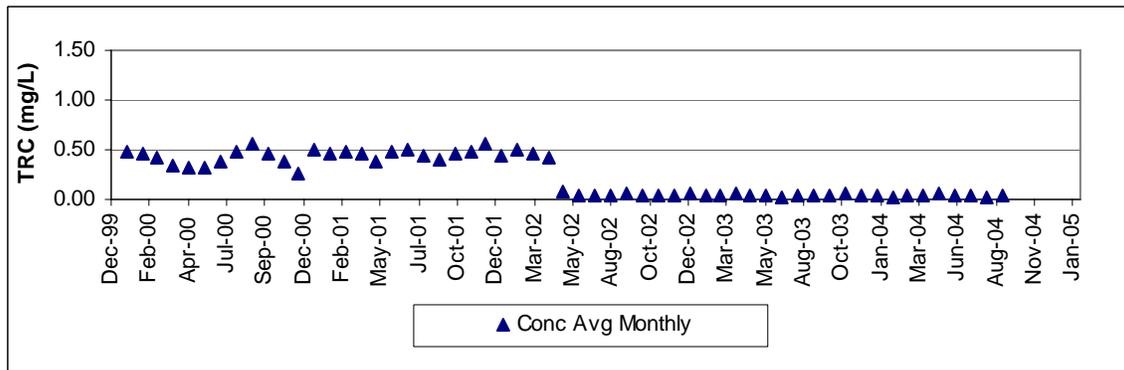


Figure B.206: Sleighton School STP Flow Quantity

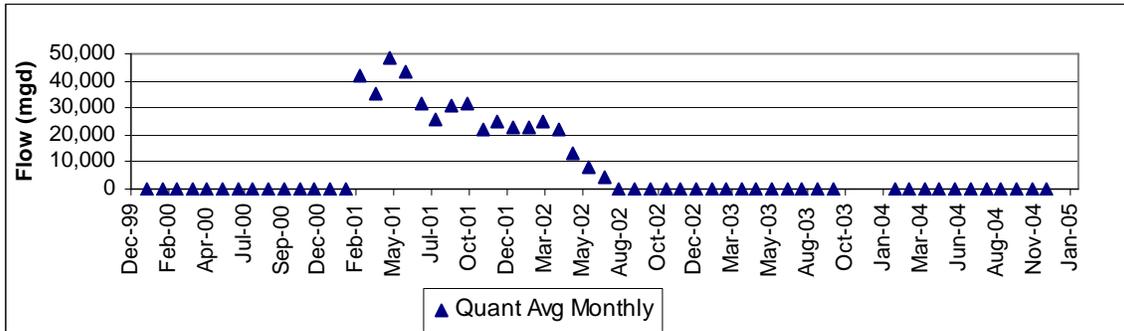


Figure B.207: Sleighton School STP CBOD5 Quantity

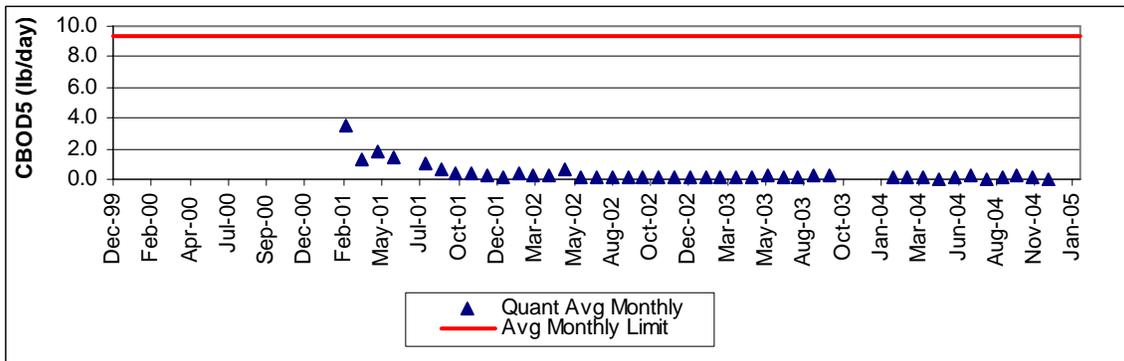


Figure B.208: Sleighton School STP CBOD5 Concentration

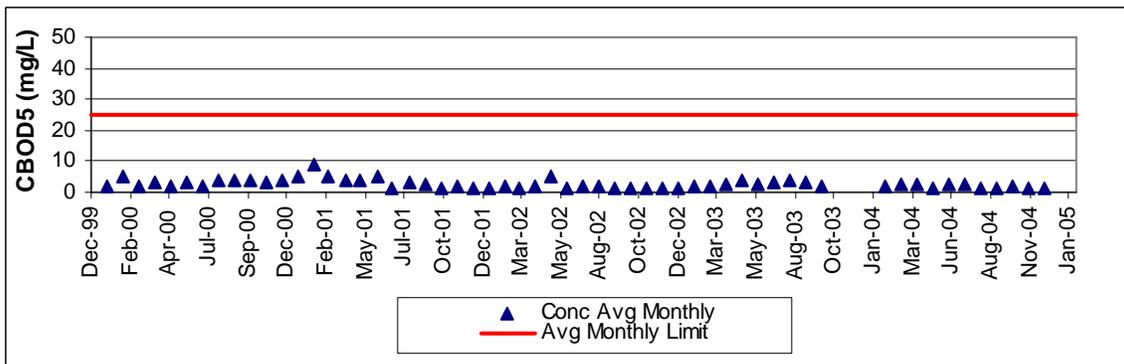


Figure B.209: Sleighton School STP pH Concentration

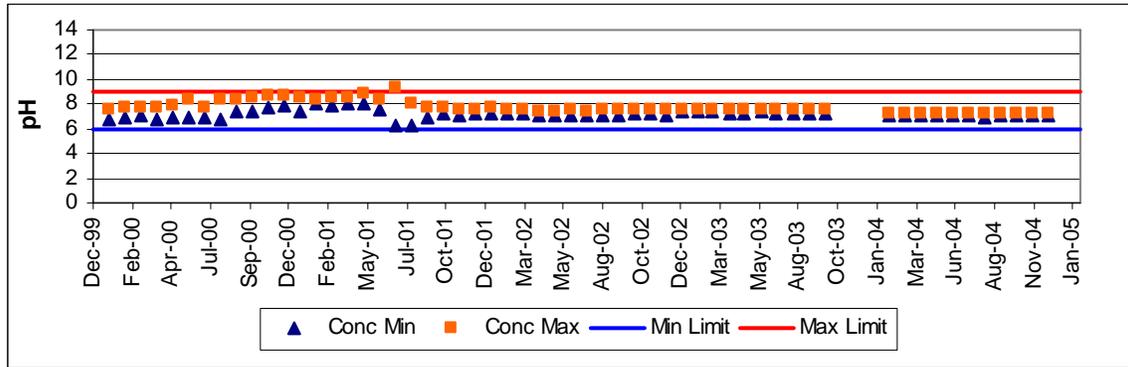


Figure B.210: Sleighton School STP TSS Quantity

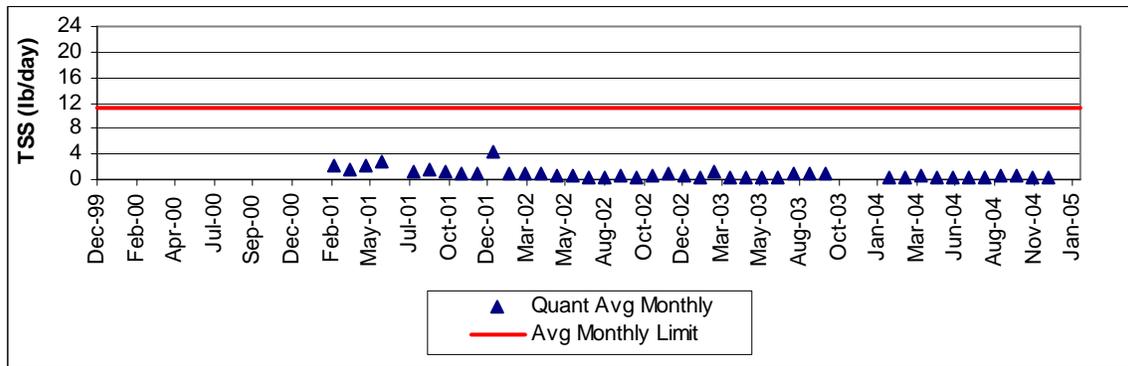


Figure B.211: Sleighton School STP TSS Concentration

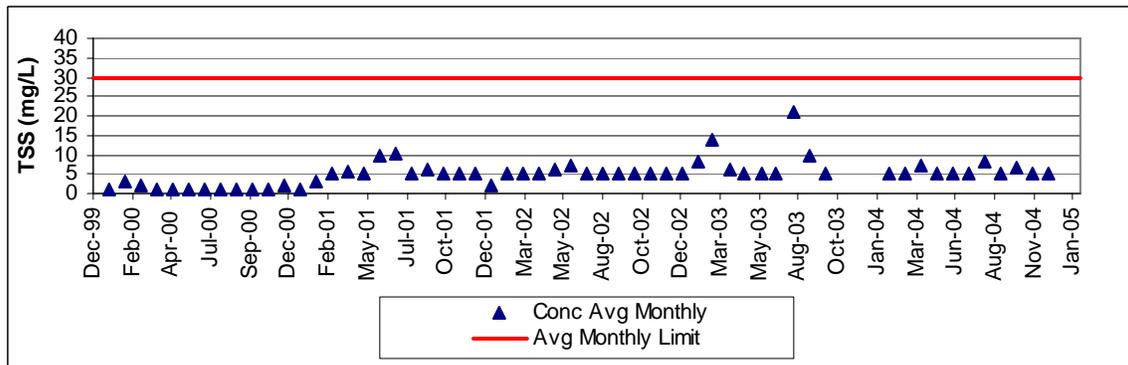


Figure B.212: Sleighton School STP Dissolved Oxygen Concentration

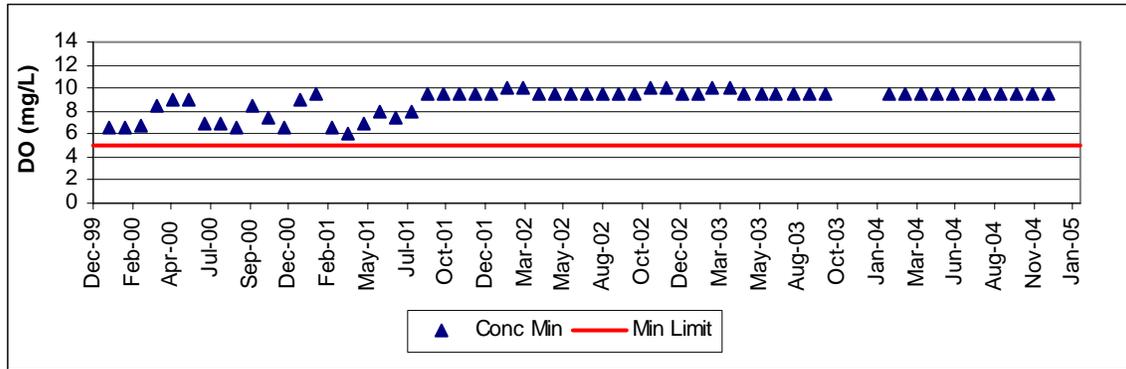


Figure B.213: Sleighton School STP Ammonia Quantity

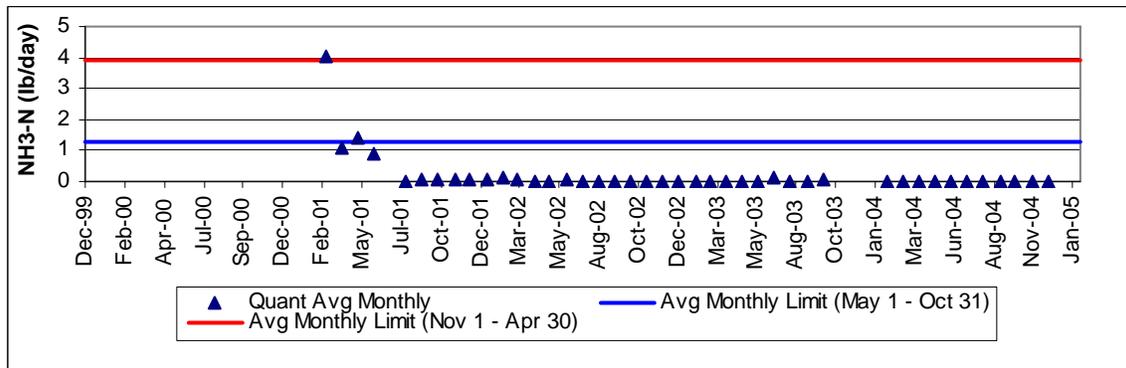


Figure B.214: Sleighton School STP Ammonia Concentration

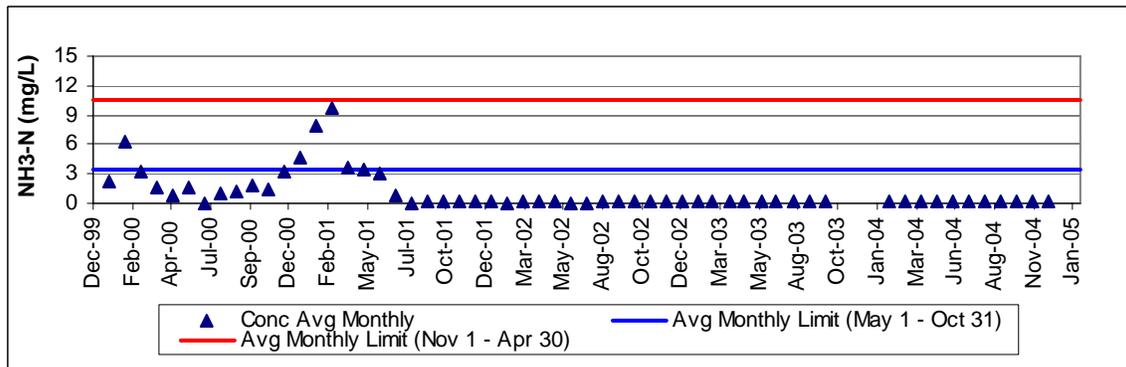


Figure B.215: Sleighton School STP Fecal Coliform Concentration

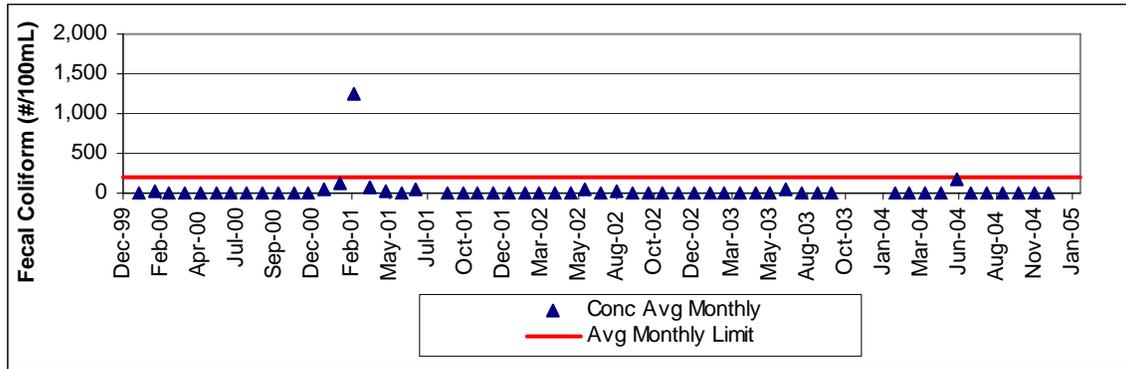


Figure B.216: Sleighton School STP TRC Concentration

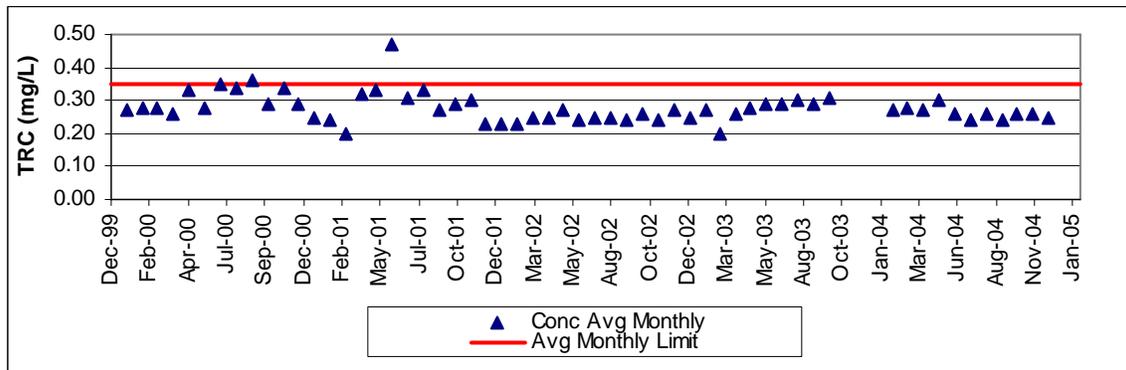


Figure B.217: Wawa Food Market #133 GWCU Flow Quantity

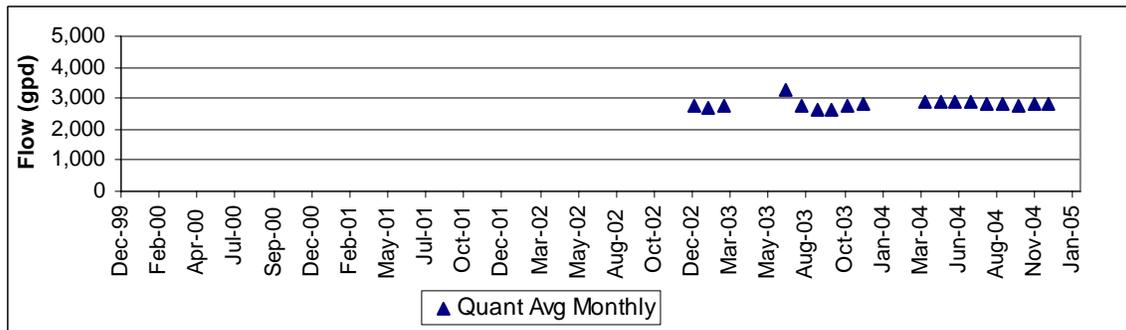


Figure B.218: Wawa Food Market #133 GWCU pH Concentration

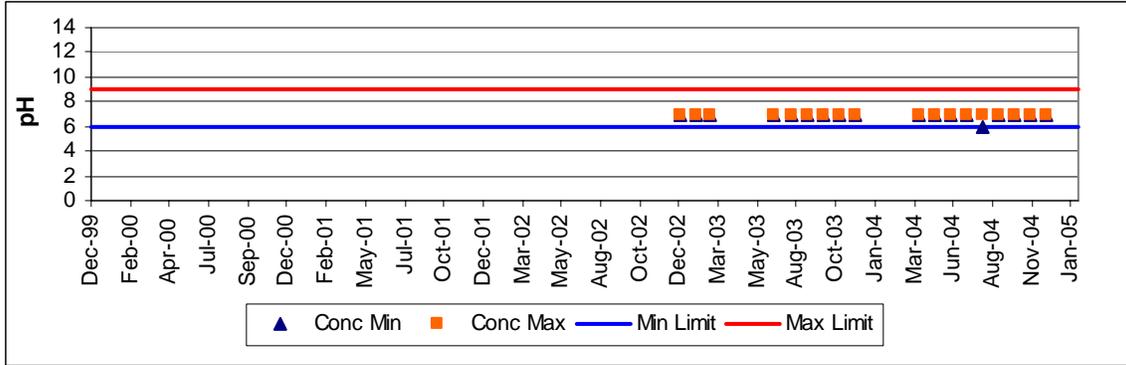


Figure B.219: Wawa Food Market #133 GWCU Benzene Concentration

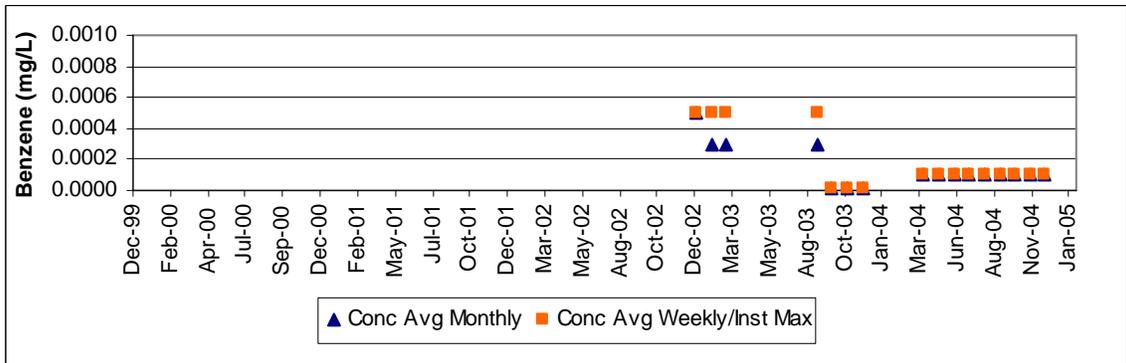


Figure B.220: Wawa Food Market #133 GWCU Ethyl Benzene Concentration

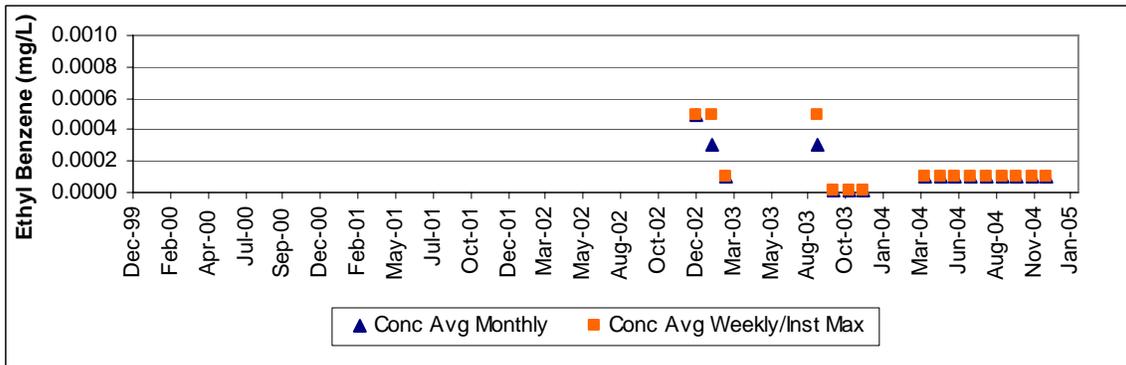


Figure B.221: Wawa Food Market #133 GWCU Dissolved Iron Concentration

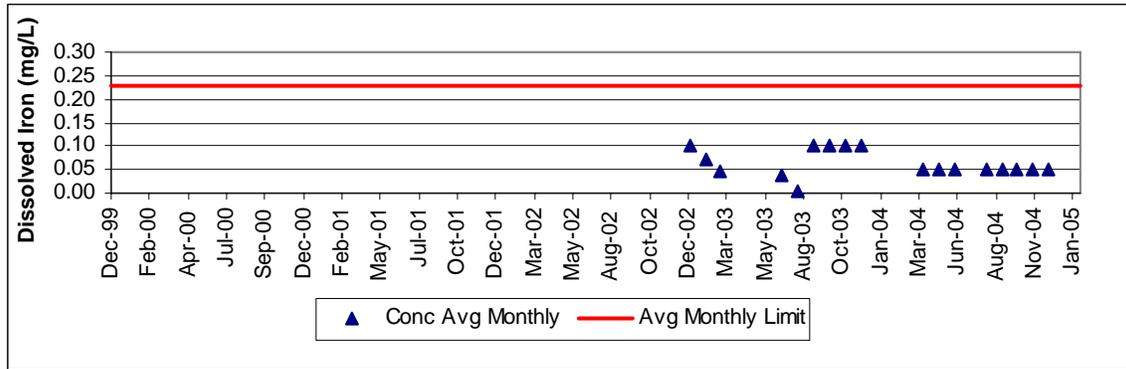


Figure B.222: Wawa Food Market #133 GWCU MTBE Concentration

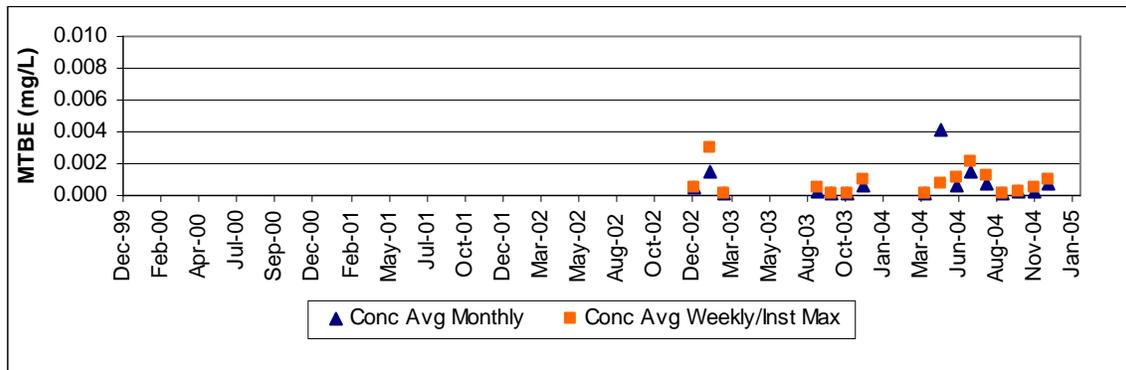


Figure B.223: Wawa Food Market #133 GWCU Dissolved Nickel Concentration

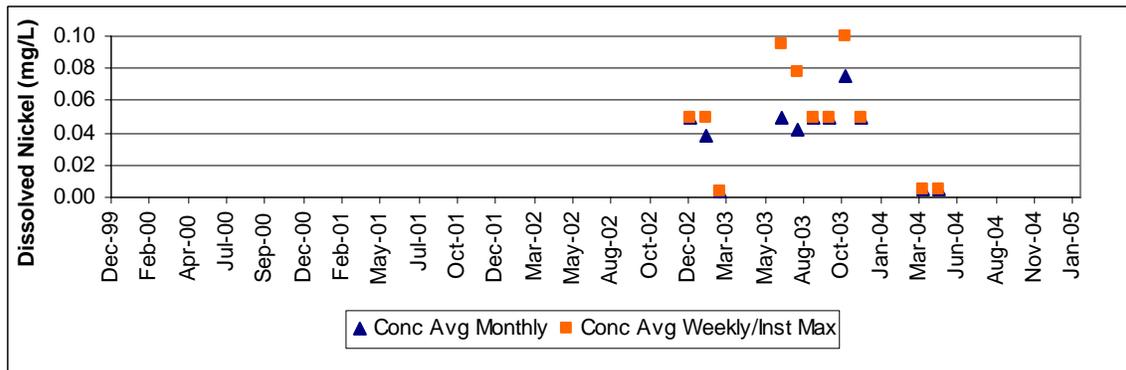


Figure 229 Wawa Food Market #133 GWCU Oil and Grease Concentration

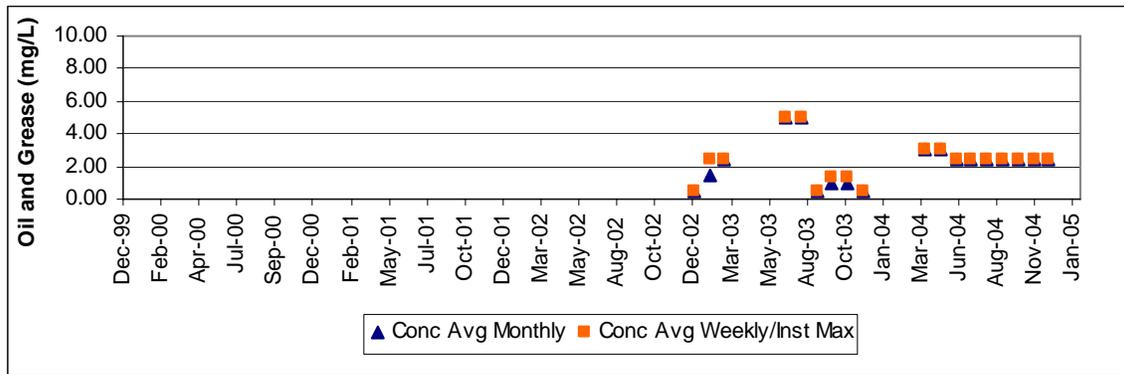


Figure B.224: Wawa Food Market #133 GWCU PCE Concentration

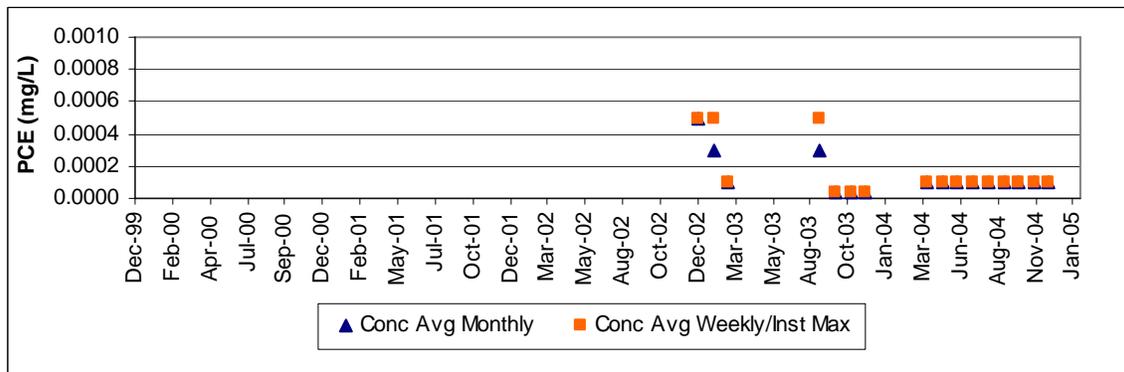


Figure B.225: Wawa Food Market #133 GWCU TCE Concentration

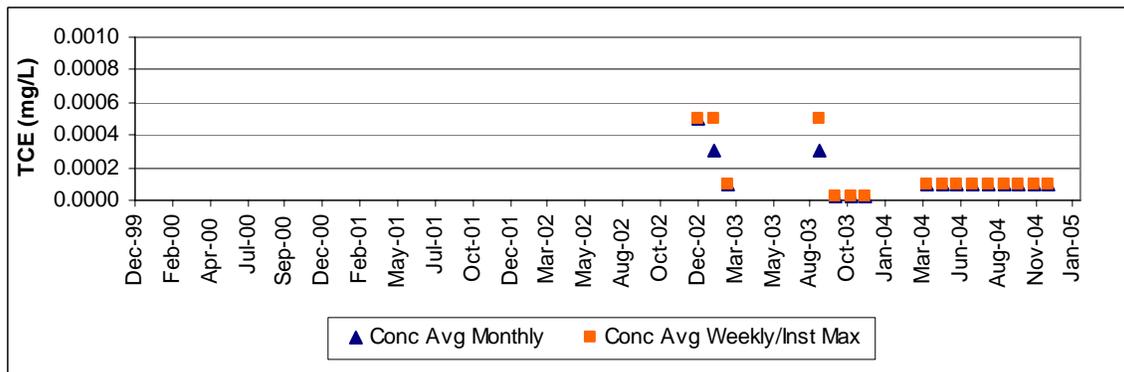


Figure 232 Wawa Food Market #133 GWCU Toluene Concentration

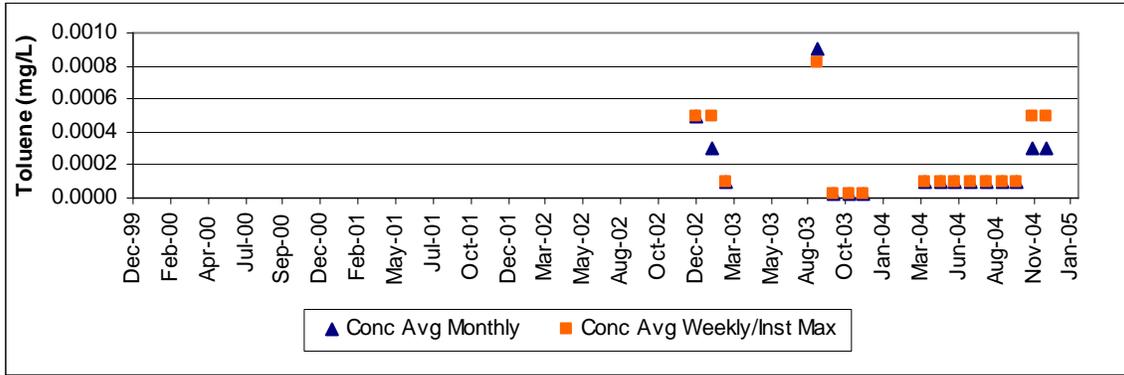


Figure B.226: Wawa Food Market #133 GWCU BETX Concentration

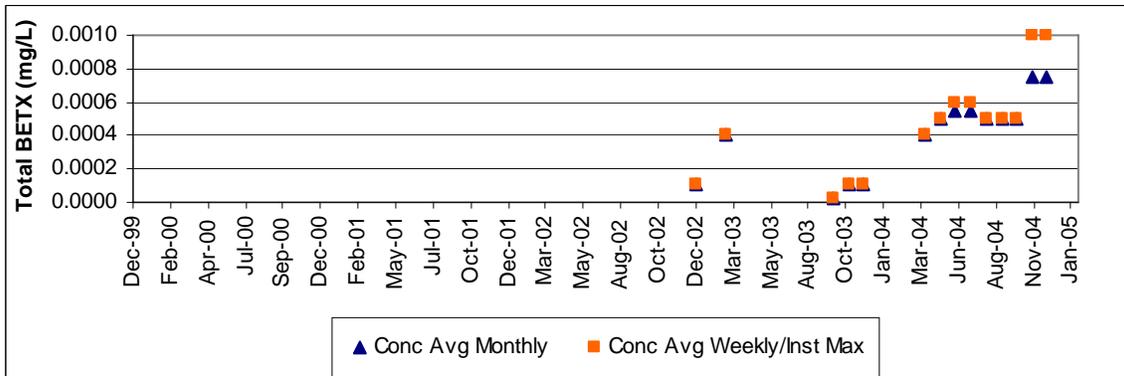


Figure B.227: Wawa Food Market #133 GWCU Xylenes Concentration

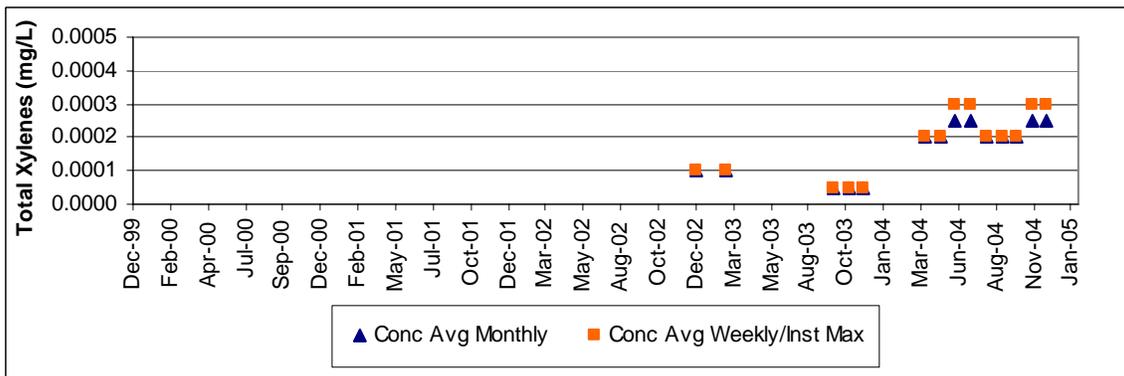


Figure B.228: Wawa Food Market #133 GWCU TSS Concentration

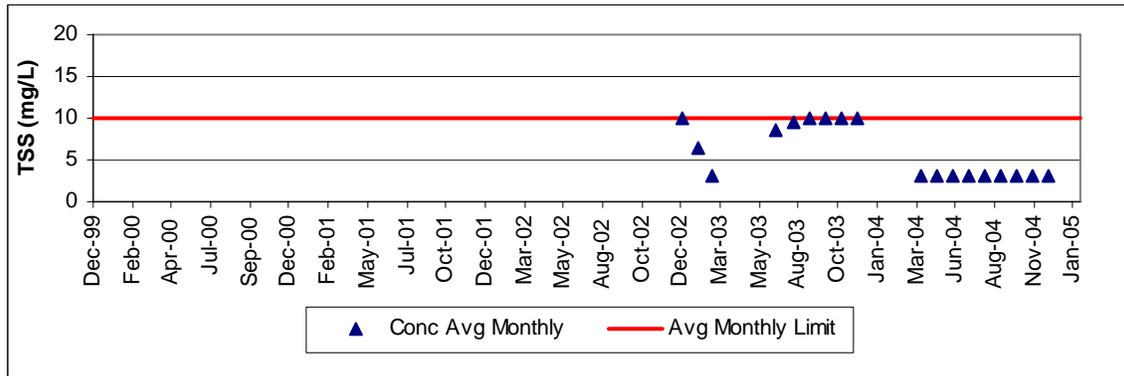


Figure B.229: Cheyney University STP Flow Quantity

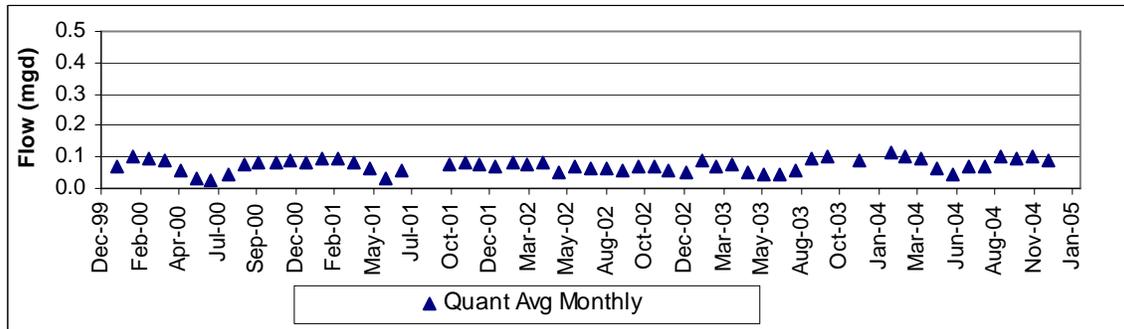


Figure B.230: Cheyney University STP CBOD5 Quantity

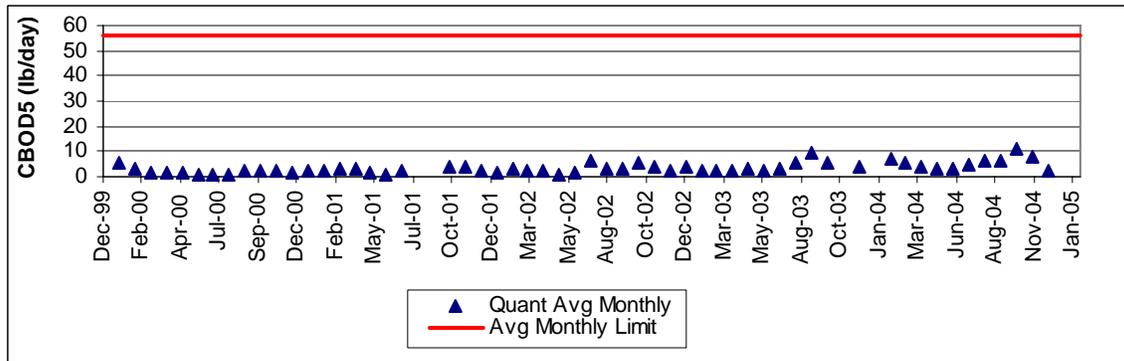


Figure B.231: Cheyney University STP CBOD5 Concentration

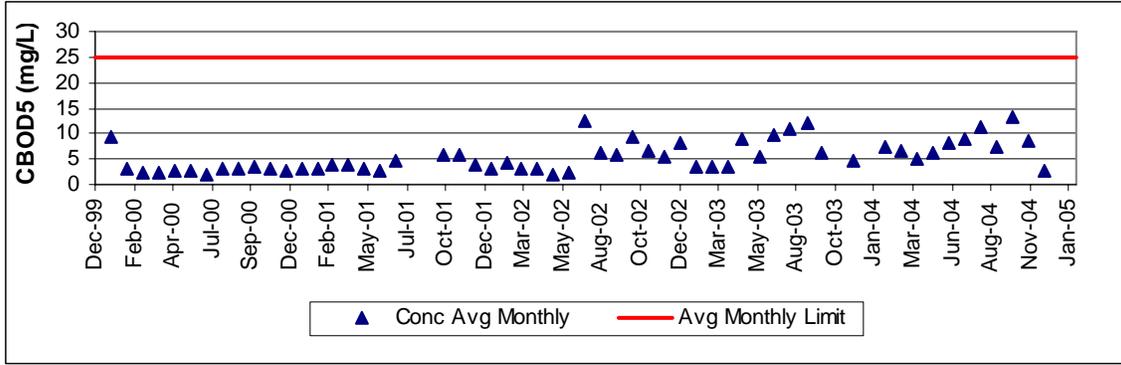


Figure B.232: Cheyney University STP pH Concentration

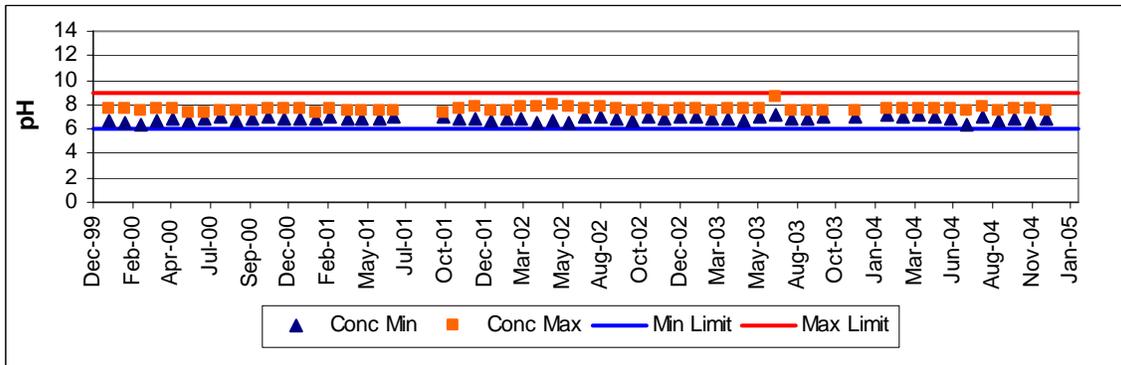


Figure B.233: Cheyney University STP TSS Quantity

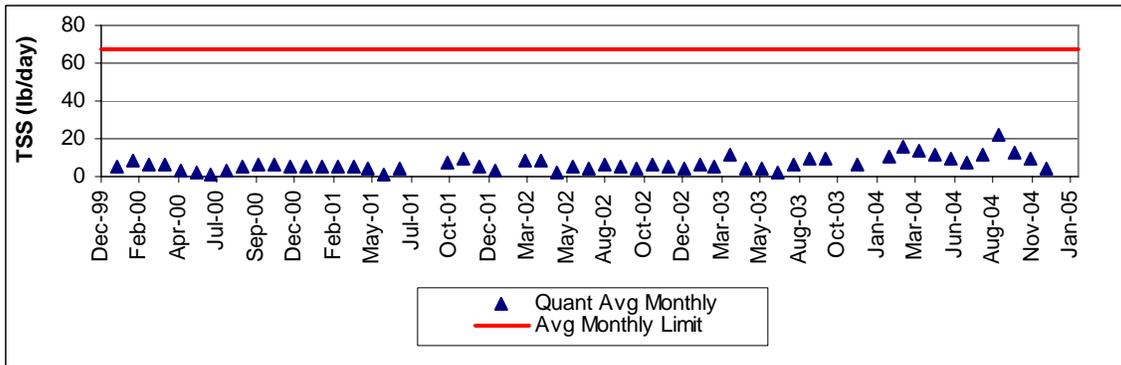


Figure B.234: Cheyney University STP TSS Concentration

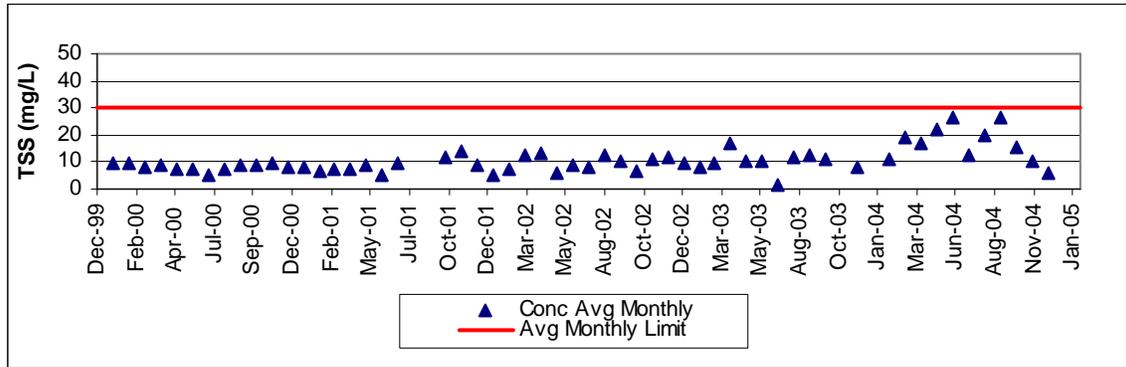


Figure B.235: Cheyney University STP Dissolved Oxygen Concentration

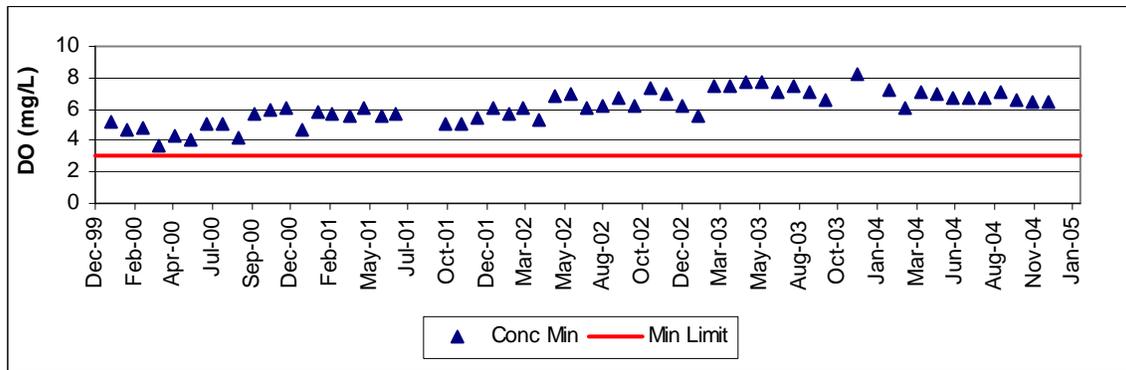


Figure B.236: Cheyney University STP Fecal Coliform Concentration

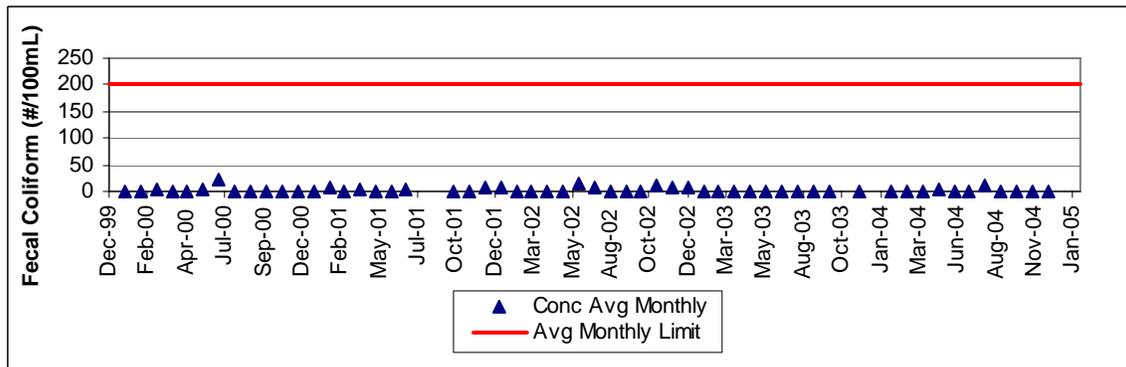


Figure B.237: Cheyney University STP Ammonia Quantity

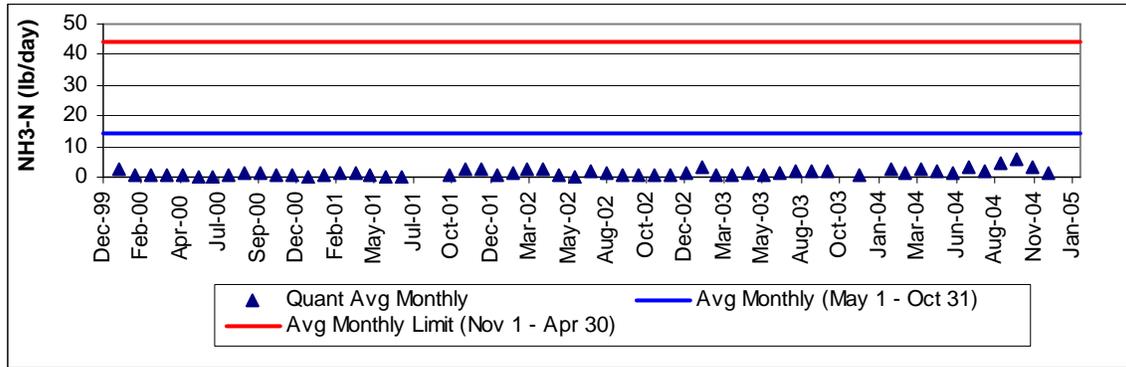


Figure B.238: Cheyney University STP Ammonia Concentration

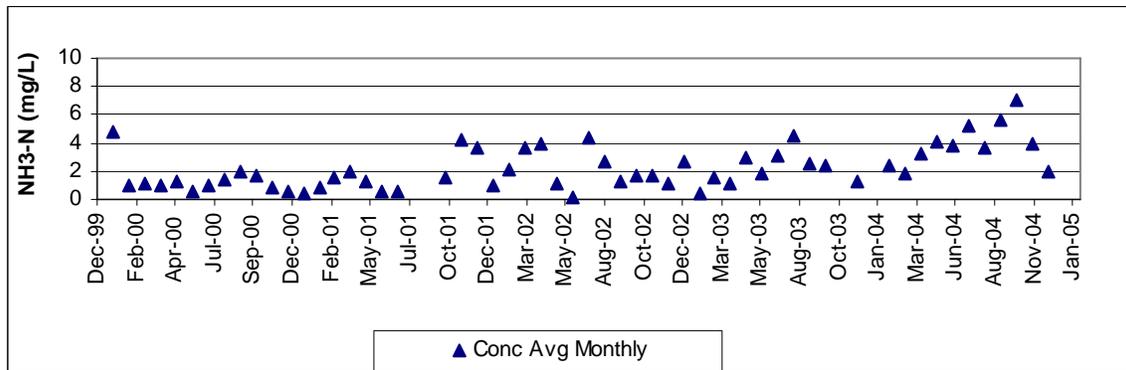


Figure B.239: Cheyney University STP TRC Concentration

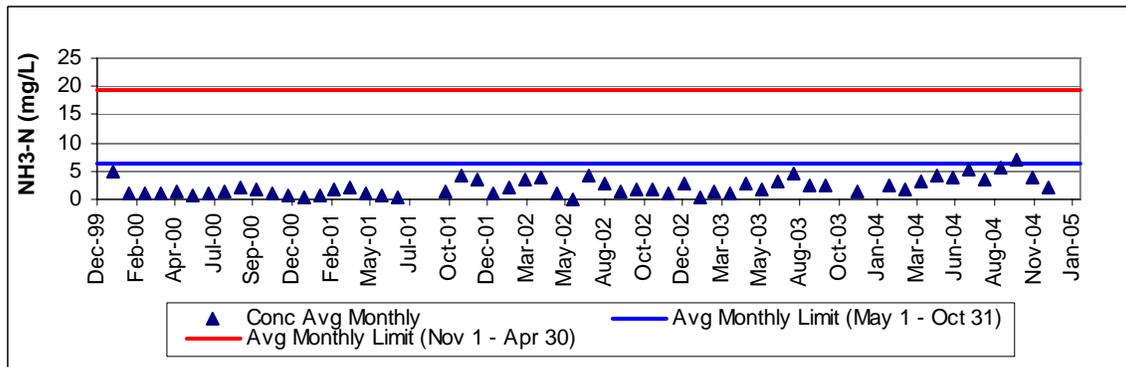


Figure B.240: Westtown-Chester Creek STP Flow Quantity

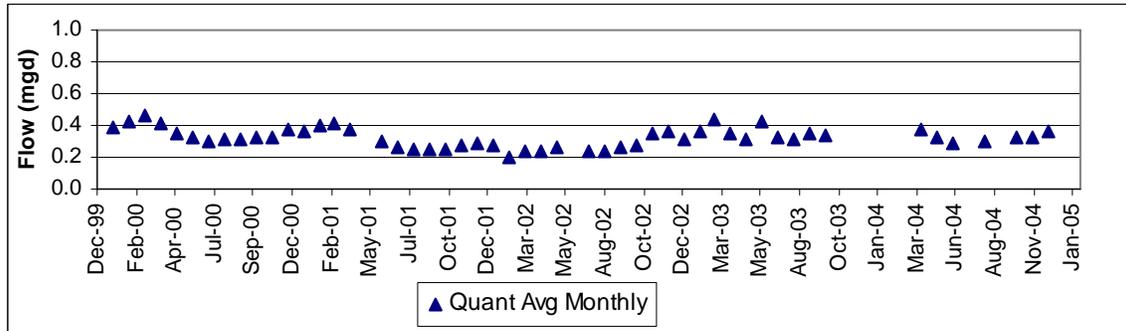


Figure B.241: Westtown-Chester Creek STP CBOD5 Quantity

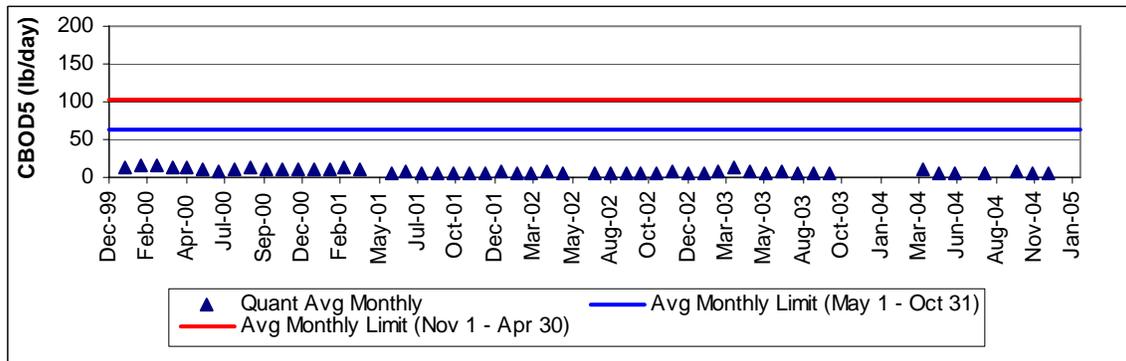


Figure B.242: Westtown-Chester Creek STP CBOD5 Concentration

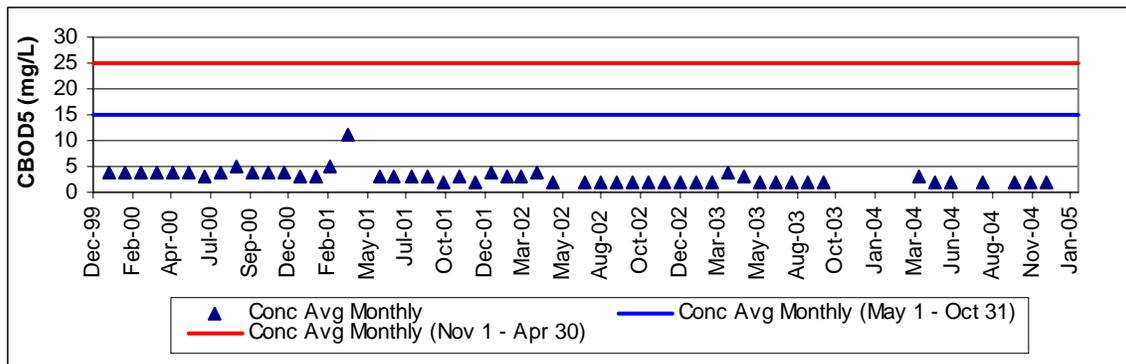


Figure B.243: Westtown-Chester Creek STP pH Concentration

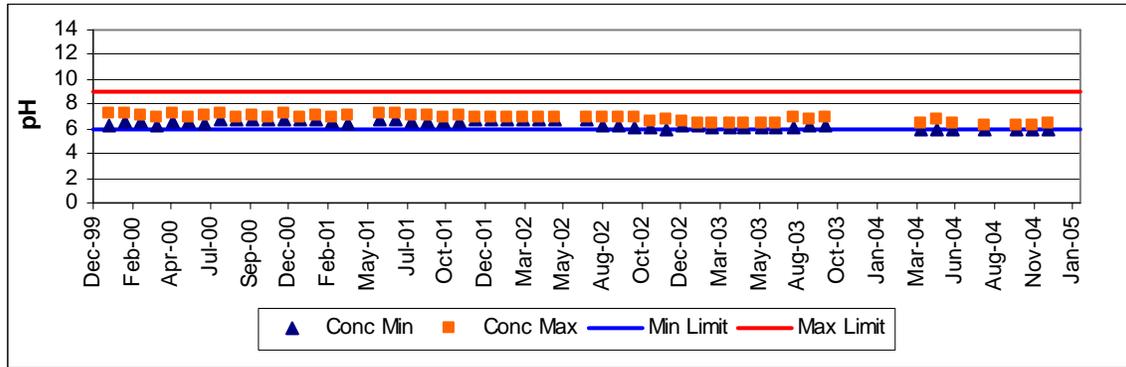


Figure B.244: Westtown-Chester Creek STP TSS Quantity

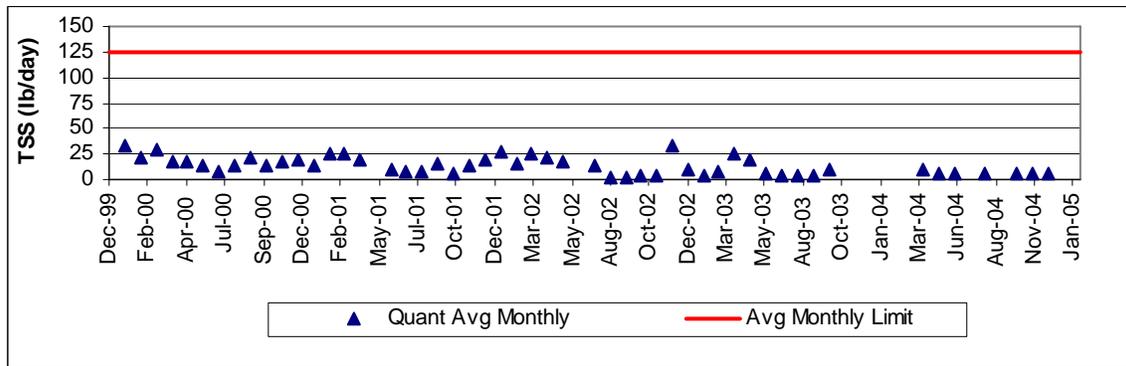


Figure B.245: Westtown-Chester Creek STP TSS Concentration

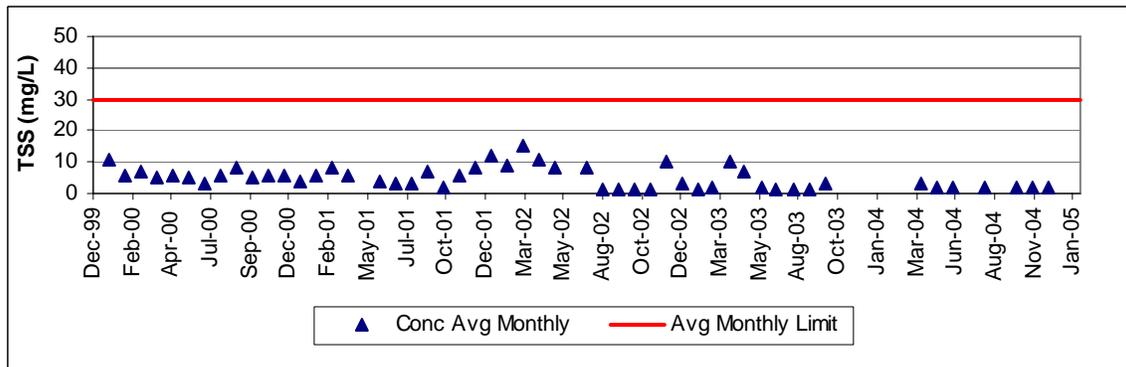


Figure B.246: Westtown-Chester Creek STP Dissolved Oxygen Concentration

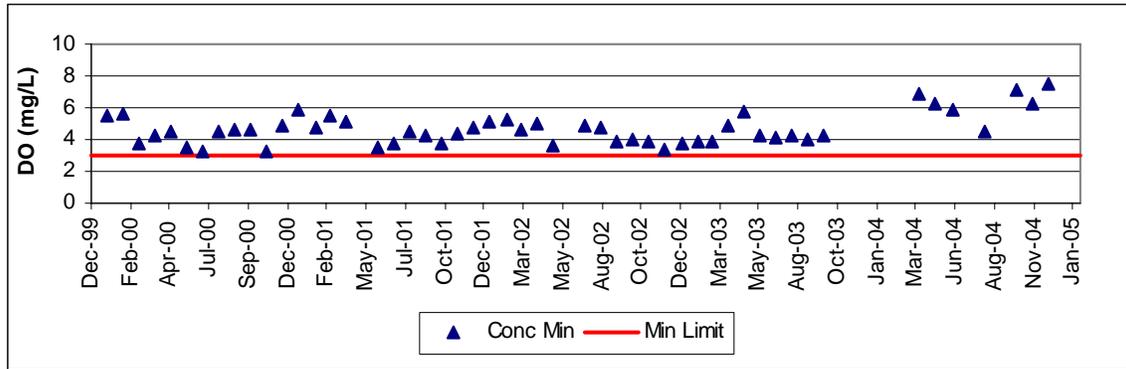


Figure B.247: Westtown-Chester Creek STP Copper Quantity

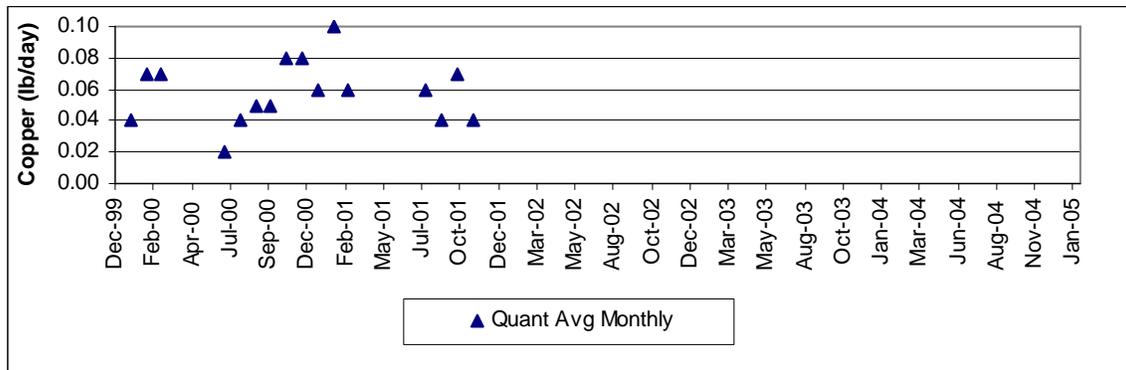


Figure B.248: Westtown-Chester Creek STP Copper Concentration

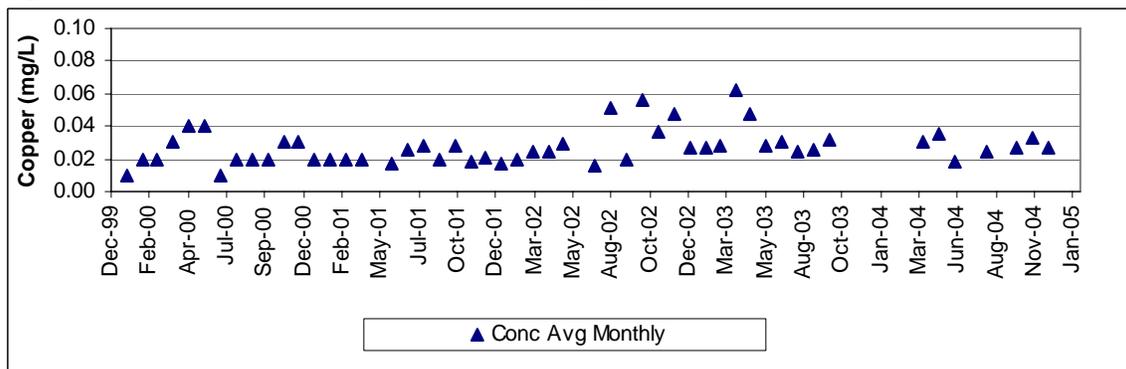


Figure B.249: Westtown-Chester Creek STP Ammonia Quantity

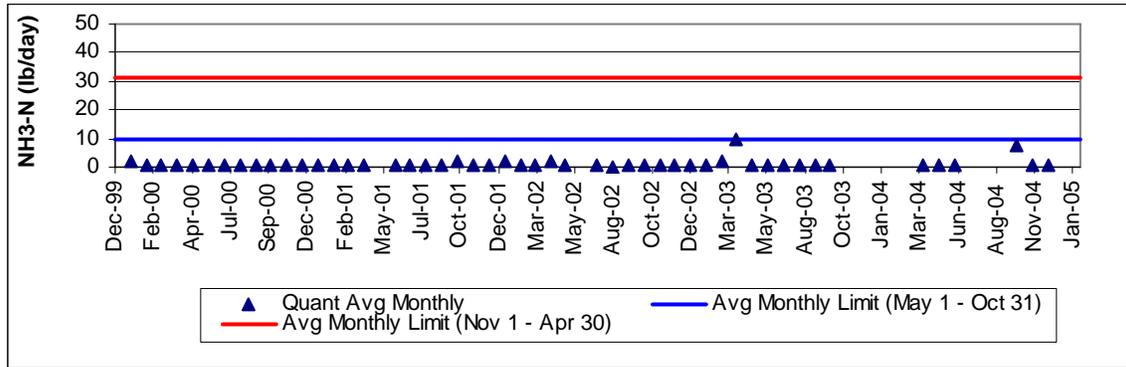


Figure B.250: Westtown-Chester Creek STP Ammonia Concentration

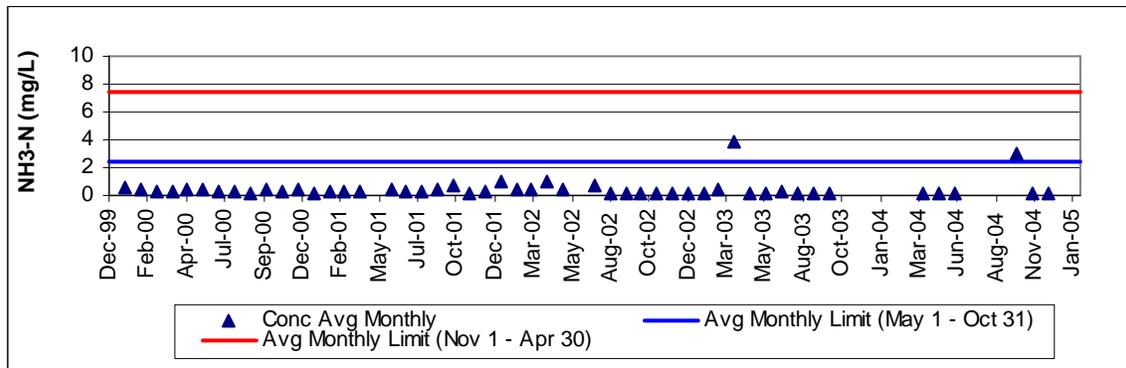


Figure B.251: Westtown-Chester Creek STP Fecal Coliform Concentration

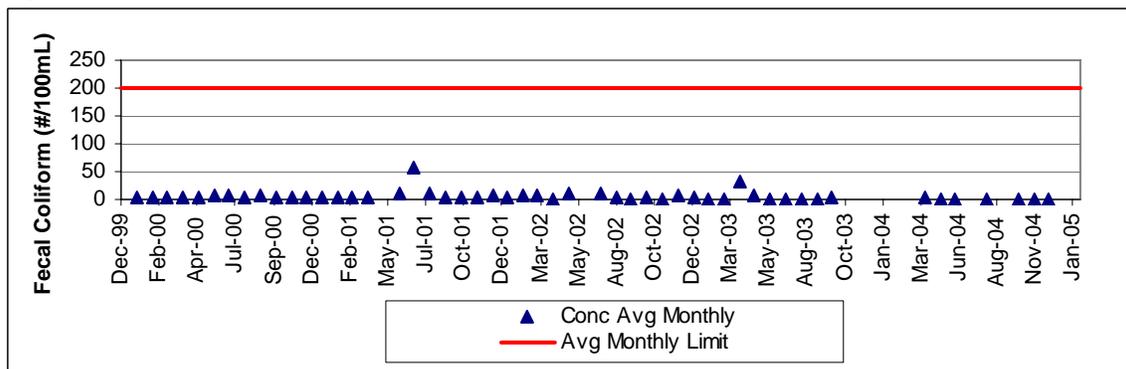


Figure B.252: Westtown-Chester Creek STP Dichlorobromomethane Concentration

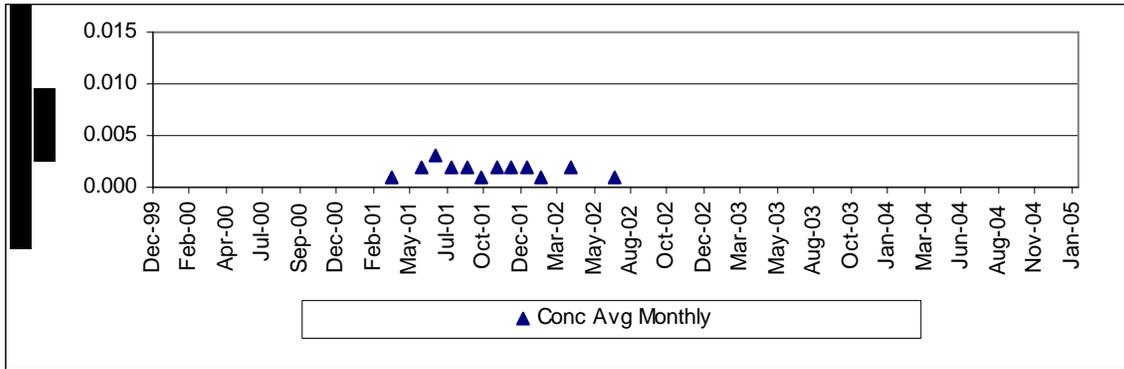


Figure B.253: Westtown-Chester Creek STP TRC Concentration

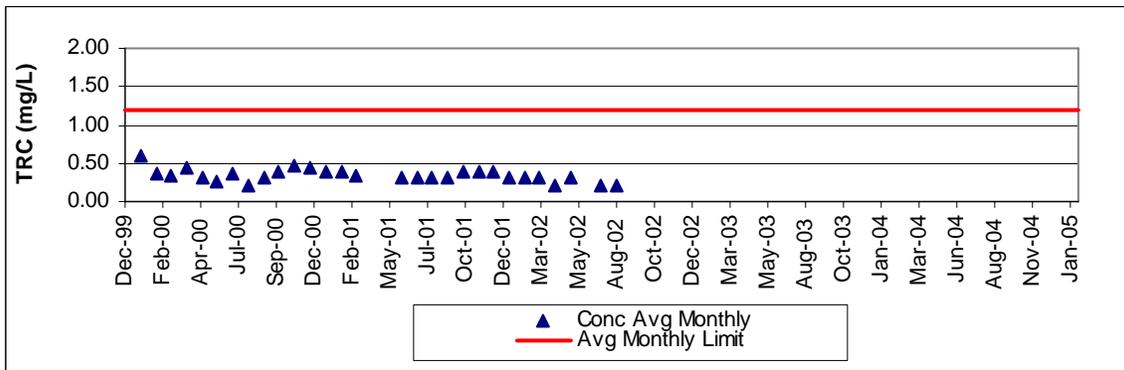


Figure B.254: Westtown School STP Flow Quantity

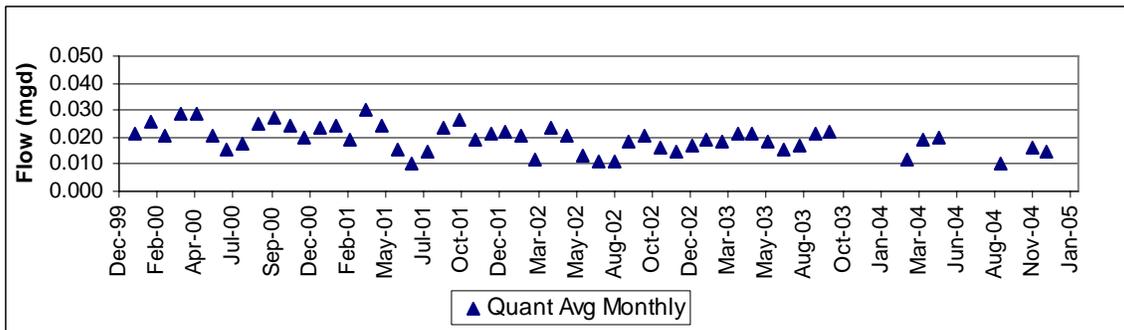


Figure B.255: Westtown School STP CBOD5 Quantity

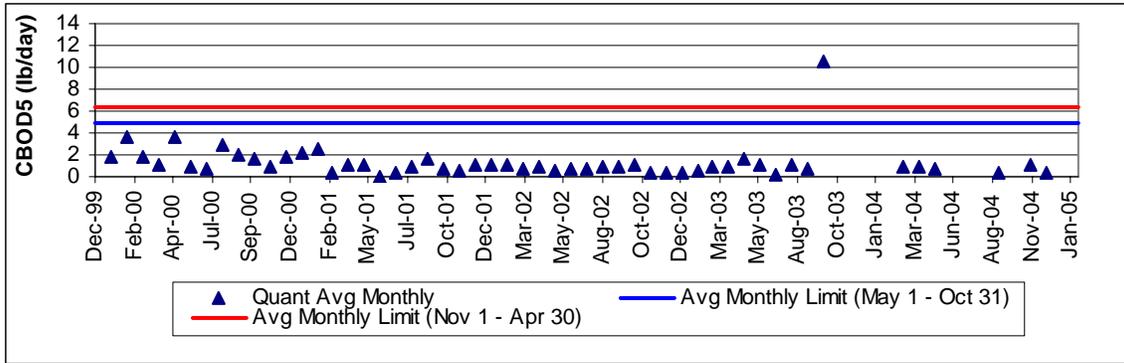


Figure B.256: Westtown School STP CBOD5 Concentration

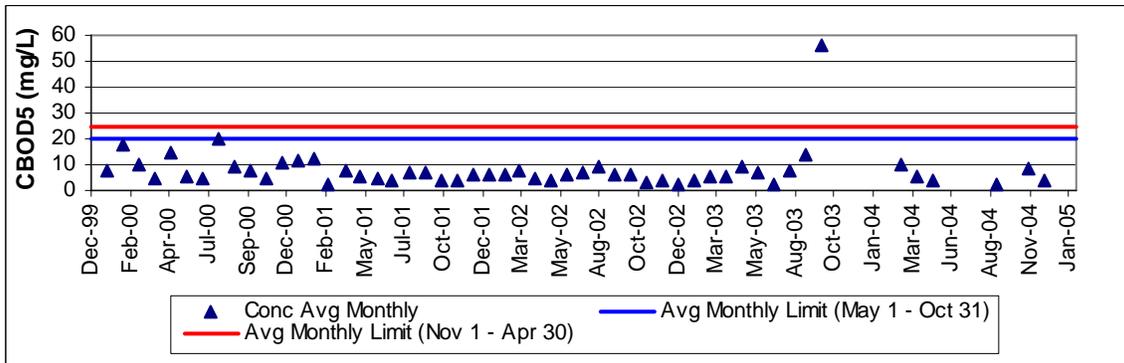


Figure B.257: Westtown School STP pH Concentration

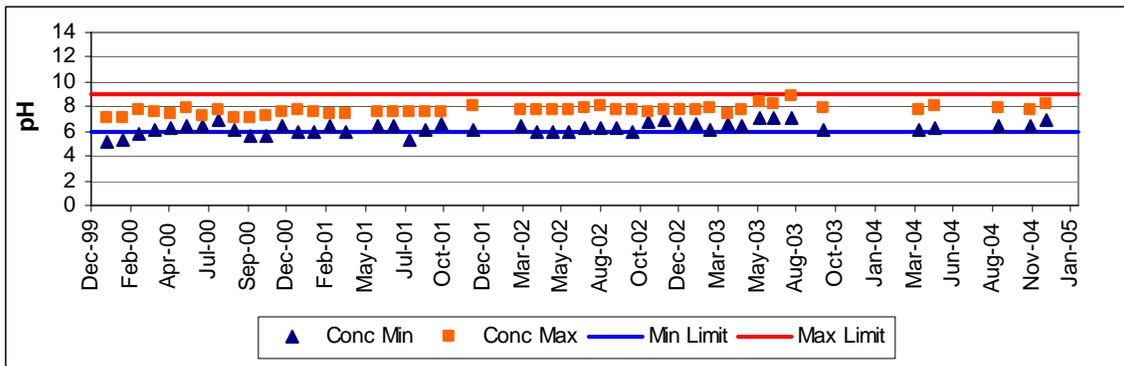


Figure B.258: Westtown School STP TSS Quantity

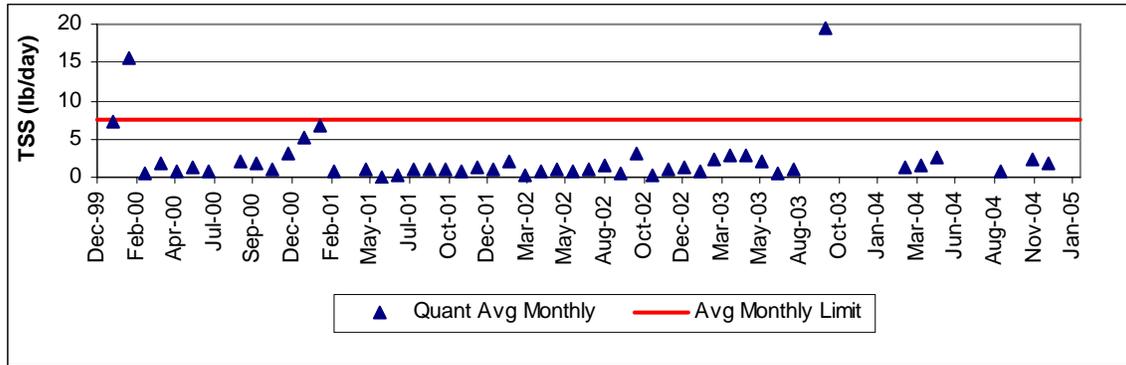


Figure B.259: Westtown School STP TSS Concentration

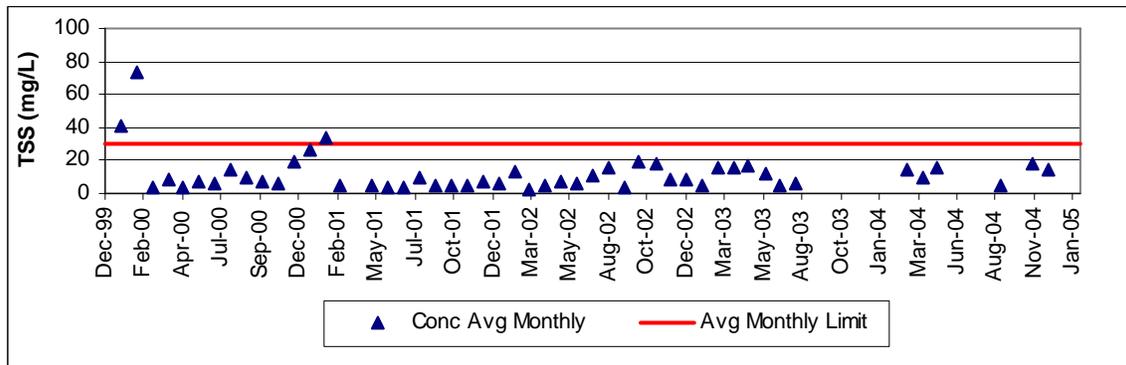


Figure B.260: Westtown School STP Dissolved Oxygen Concentration

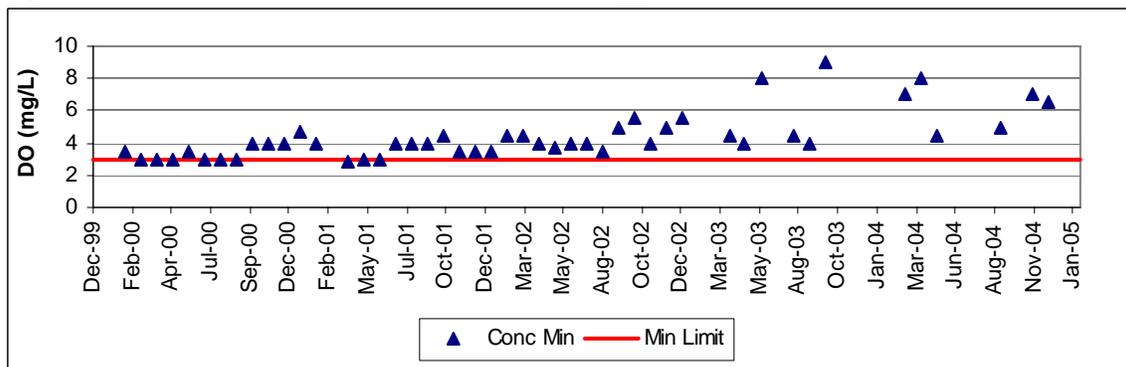


Figure B.261: Westtown School STP Fecal Coliform Concentration

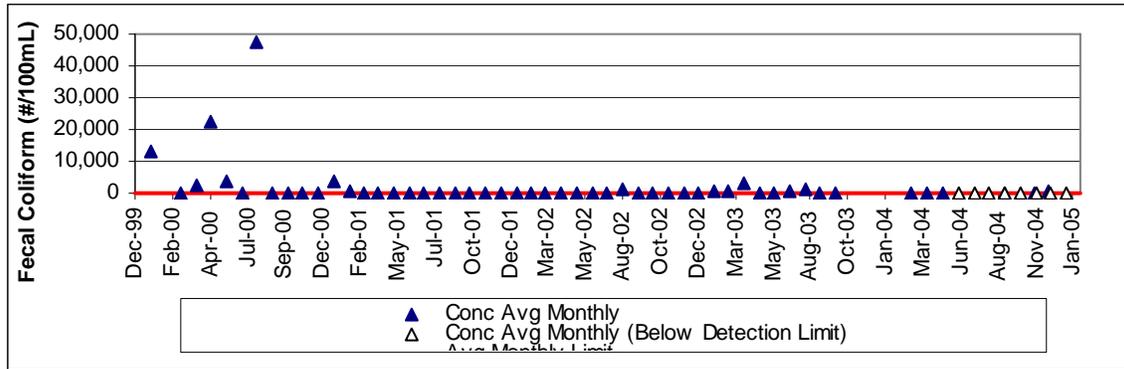


Figure B.262: Westtown School STP Ammonia Quantity

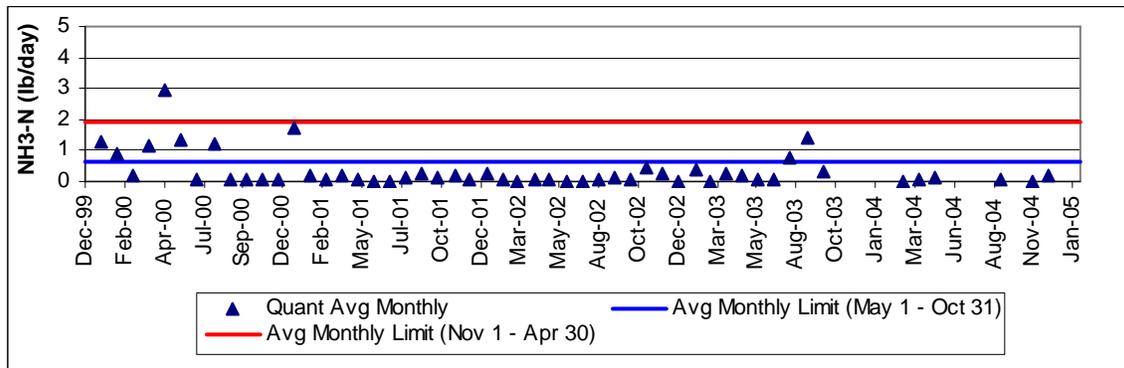


Figure B.263: Westtown School STP Ammonia Concentration

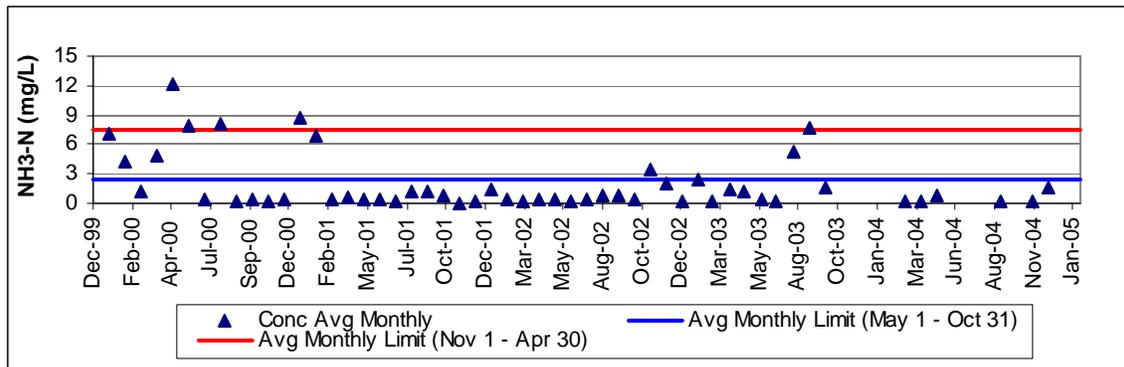


Figure B.264: Westtown School STP TRC Concentration

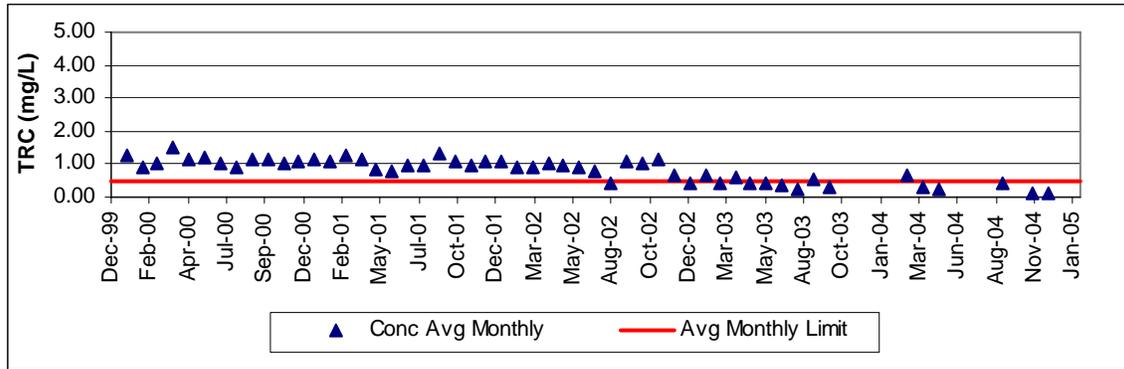


Figure B.265: Malvern School at Glen Mills Flow Quantity

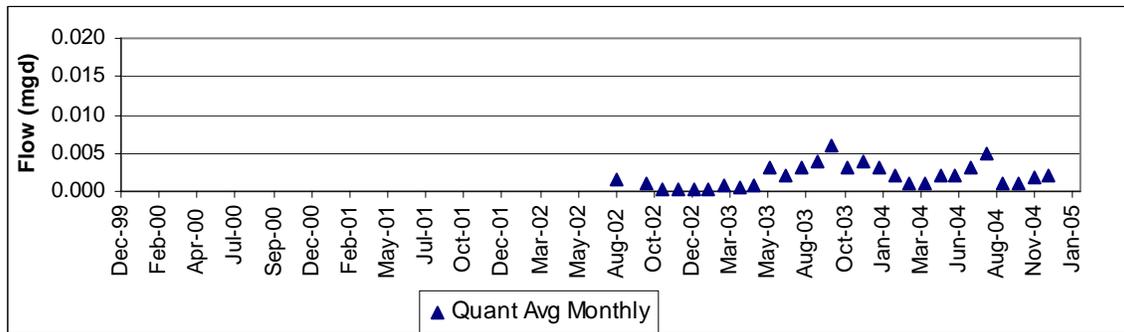


Figure B.266: Malvern School at Glen Mills CBOD5 Concentration

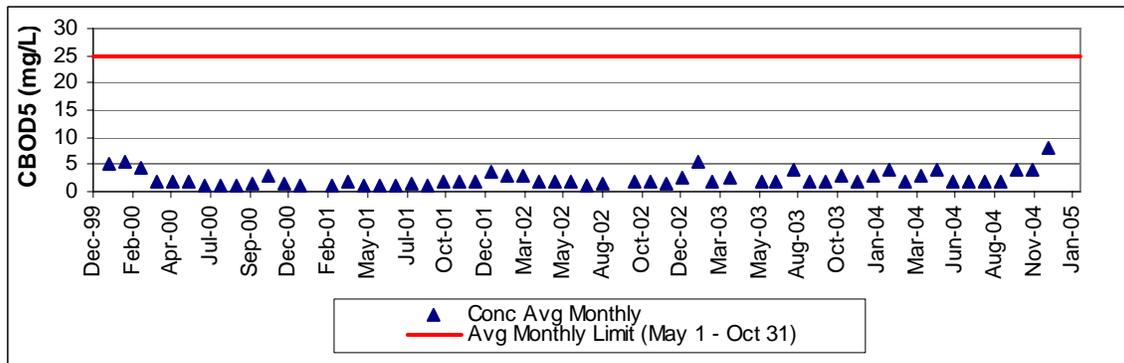


Figure B.267: Malvern School at Glen Mills pH Concentration

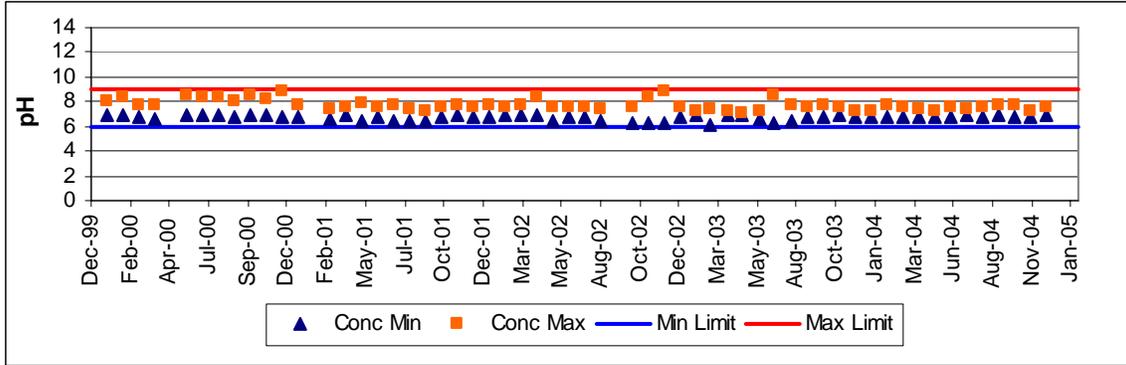


Figure B.268: Malvern School at Glen Mills TSS Concentration

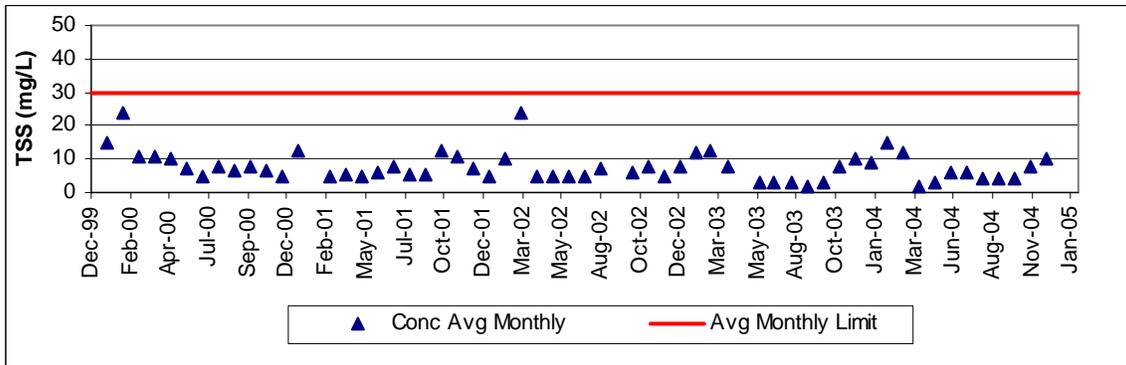


Figure B.269: Malvern School at Glen Mills Dissolved Oxygen Concentration

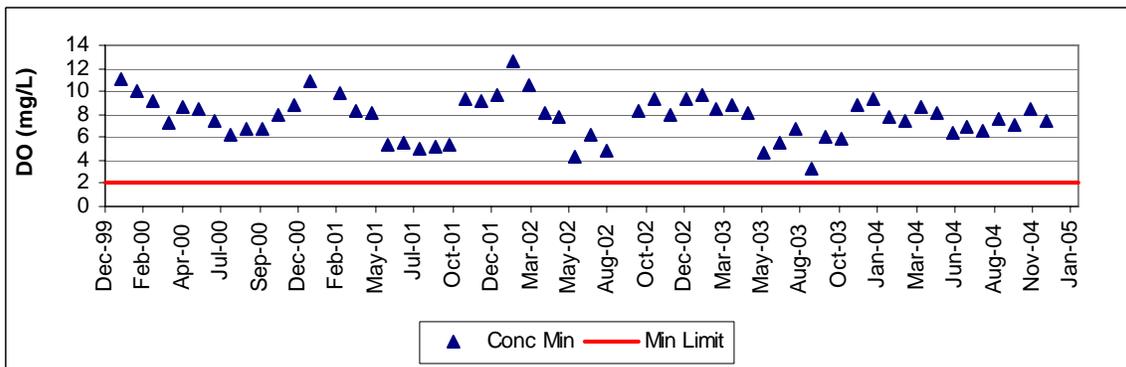


Figure B.270: Malvern School at Glen Mills Ammonia Concentration

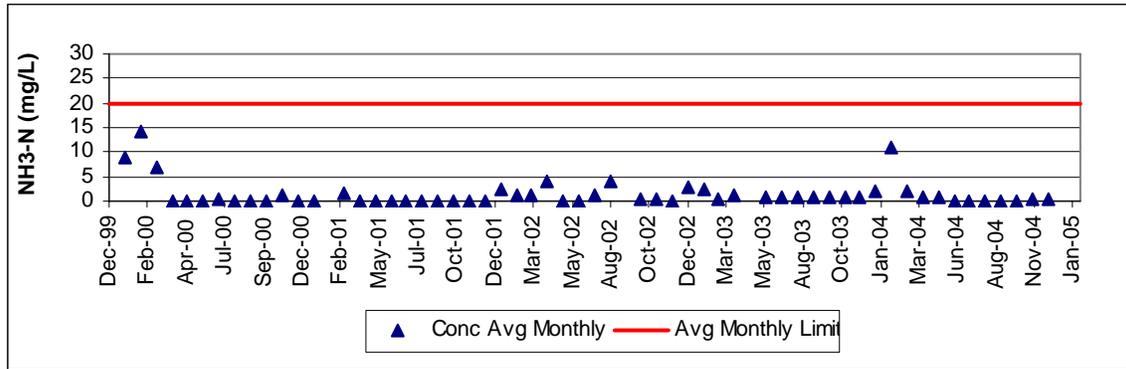


Figure B.271: Malvern School at Glen Mills Fecal Coliform Concentration

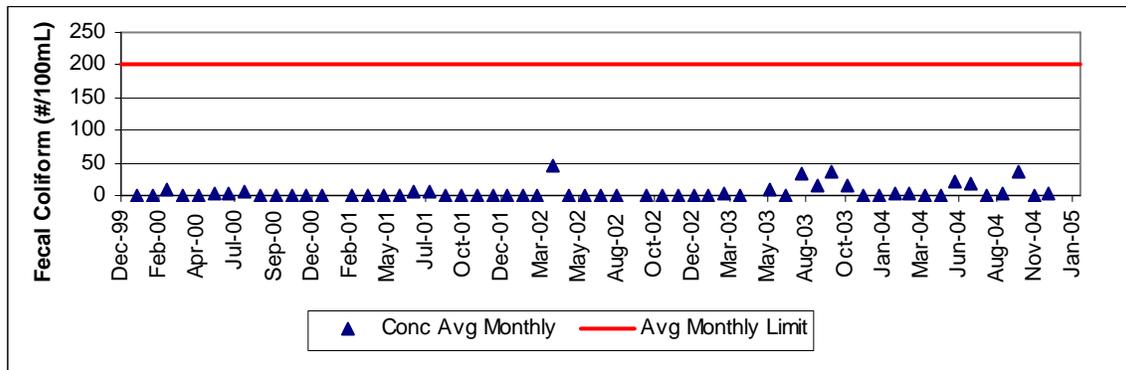


Figure B.272: Malvern School at Glen Mills TRC Concentration

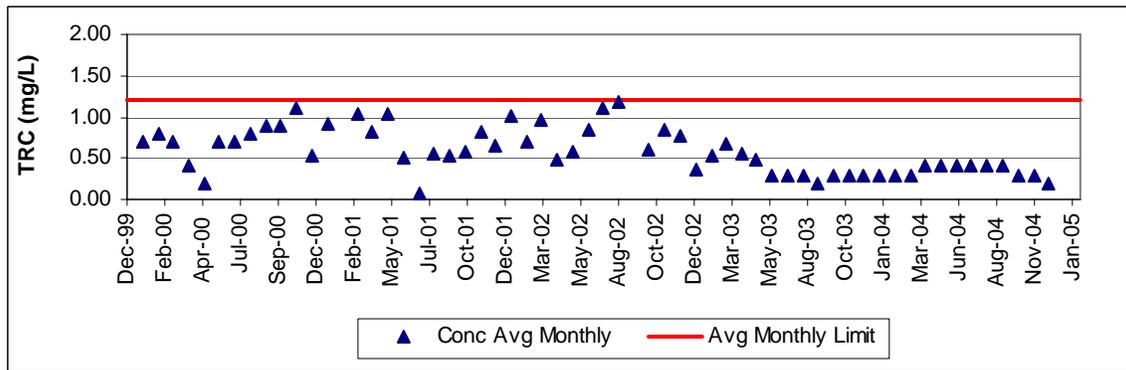


Figure B.273: West Goshen STP Average Flow

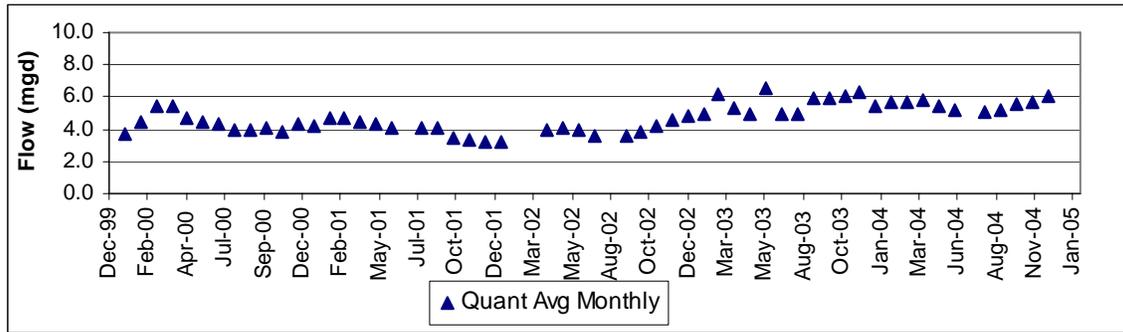


Figure B.274: West Goshen STP Average CBOD5 Quantity

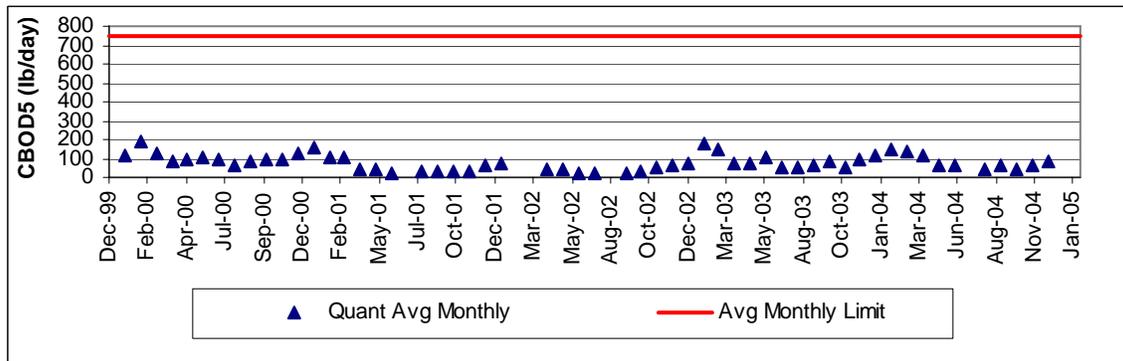


Figure B.275: West Goshen STP Average CBOD5 Concentration

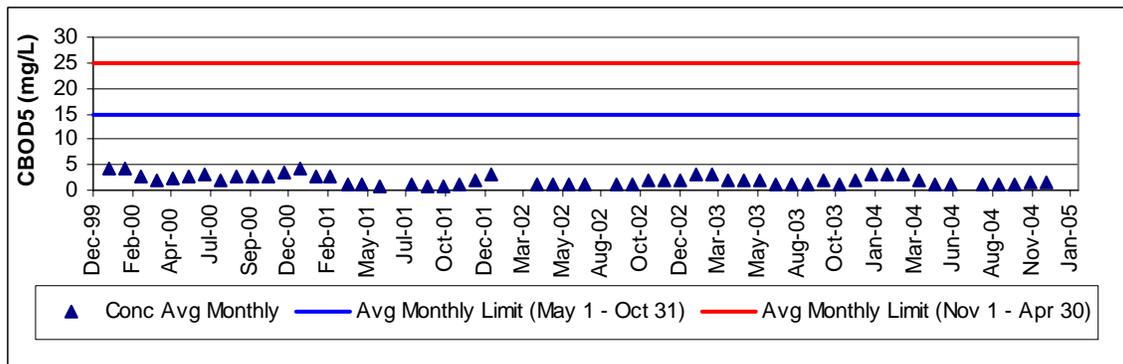


Figure B.276: West Goshen STP pH Concentration

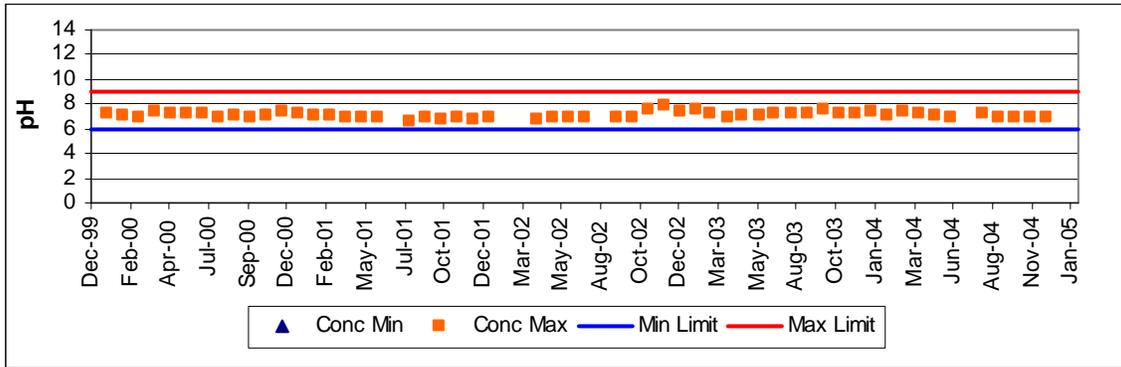


Figure B.277: West Goshen STP Average TSS Quantity

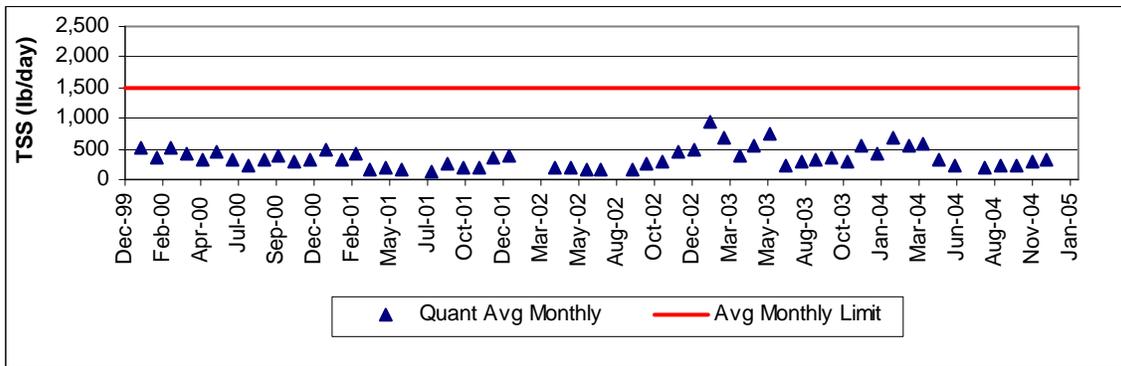


Figure B.278: West Goshen STP Average TSS Concentration

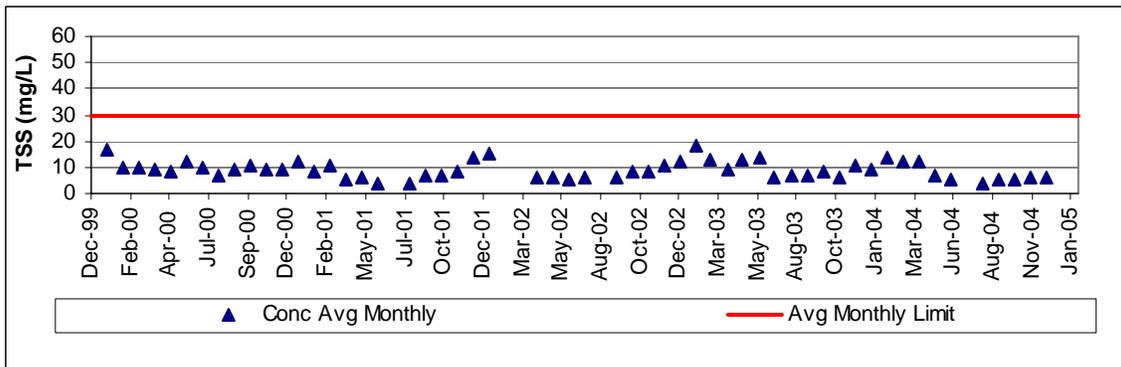


Figure B.279: West Goshen STP Average DO Concentration

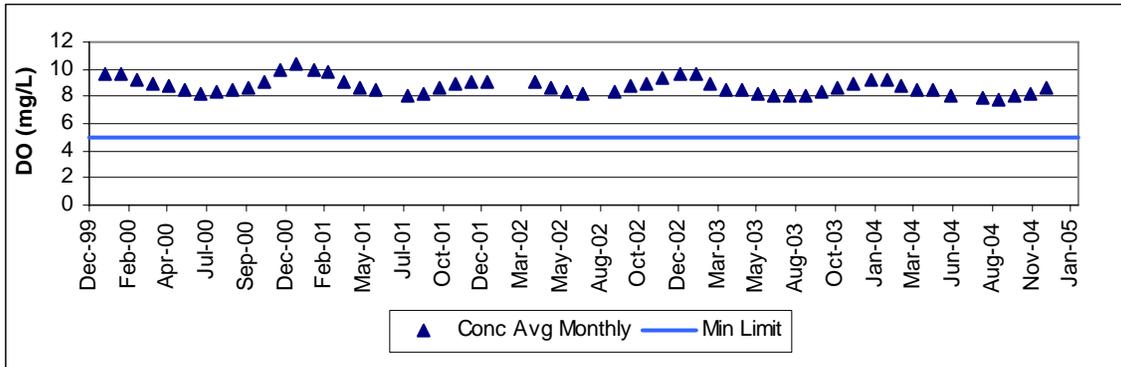


Figure B.280: West Goshen STP Average Copper Concentration

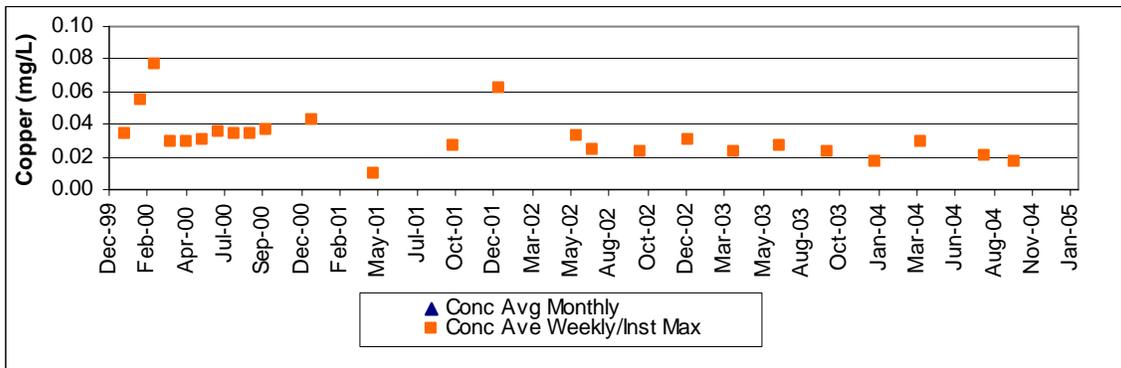


Figure B.281: West Goshen STP Average Copper Quantity

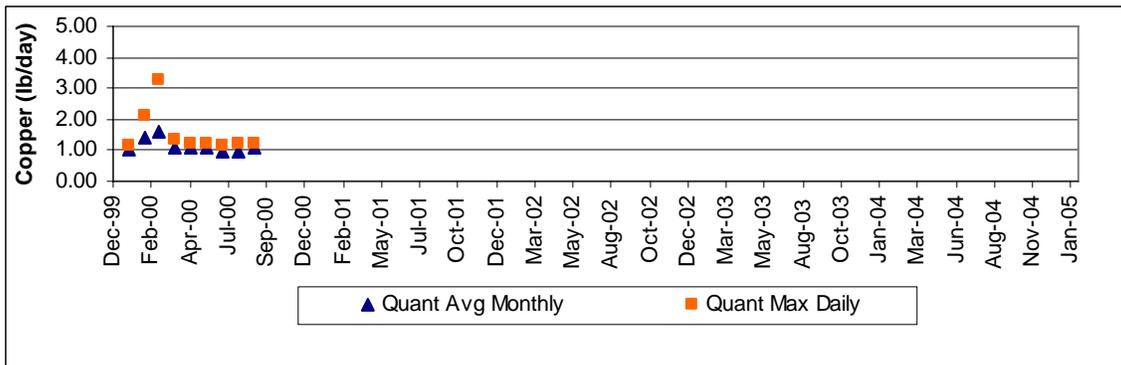


Figure B.282: West Goshen STP Average Ammonia Quantity

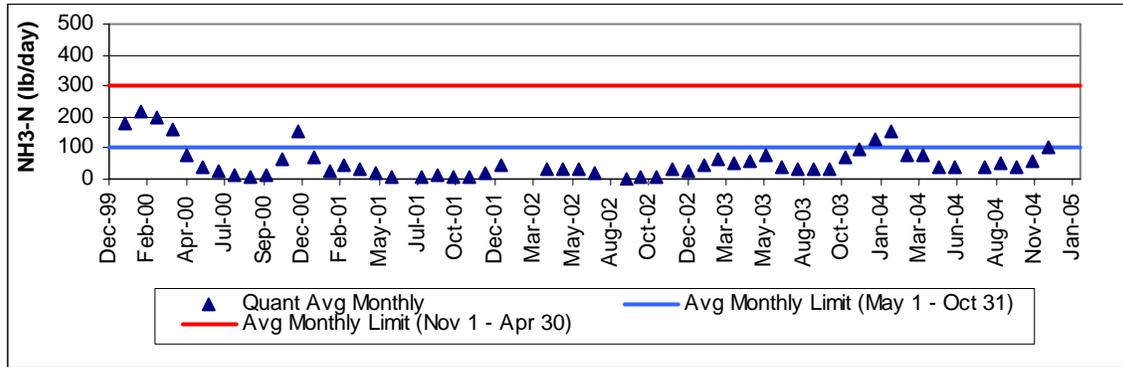


Figure B.283: West Goshen STP Average Ammonia Concentration

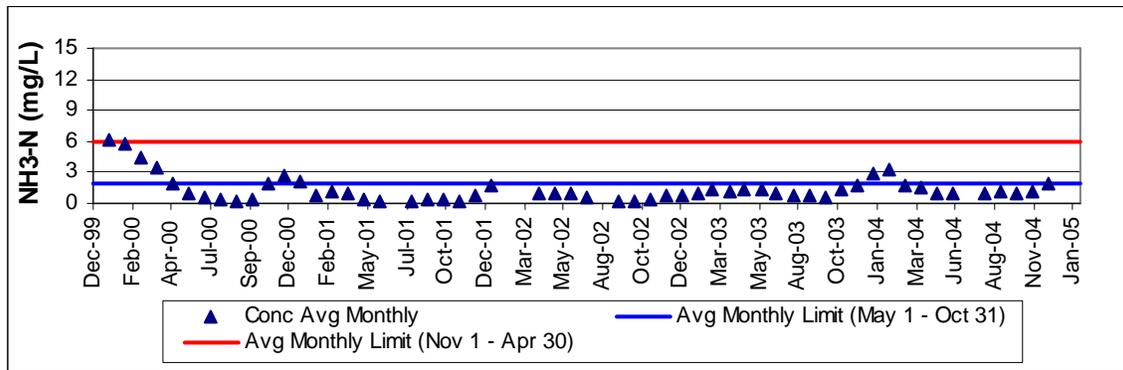


Figure B.284: West Goshen STP Fecal Coliform Concentration

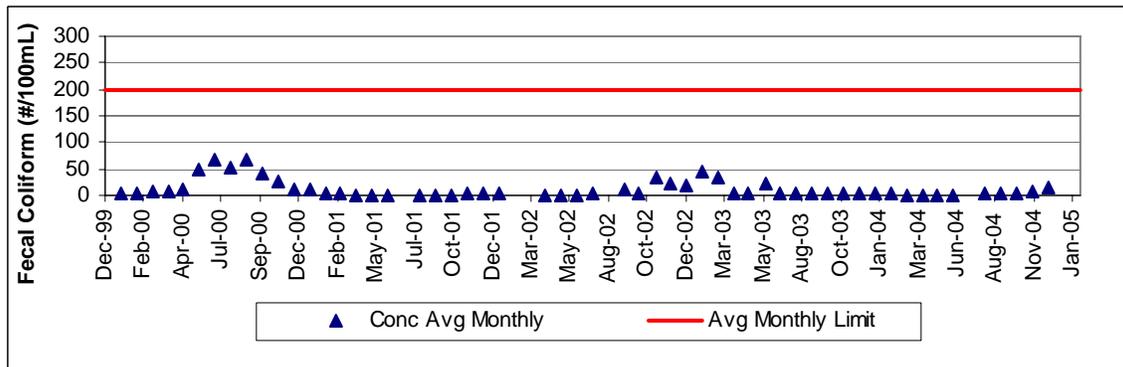


Figure B.285: West Goshen STP TRC Concentration

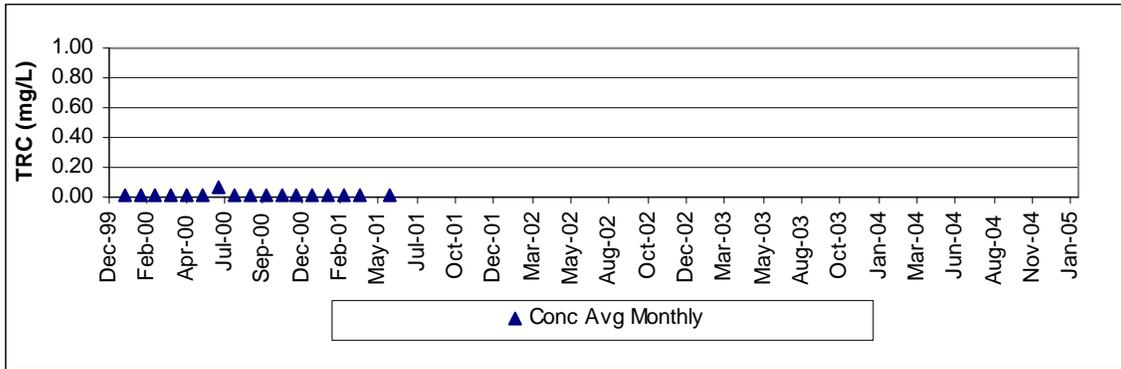


Figure B.286: West Goshen STP Phosphorus Quantity

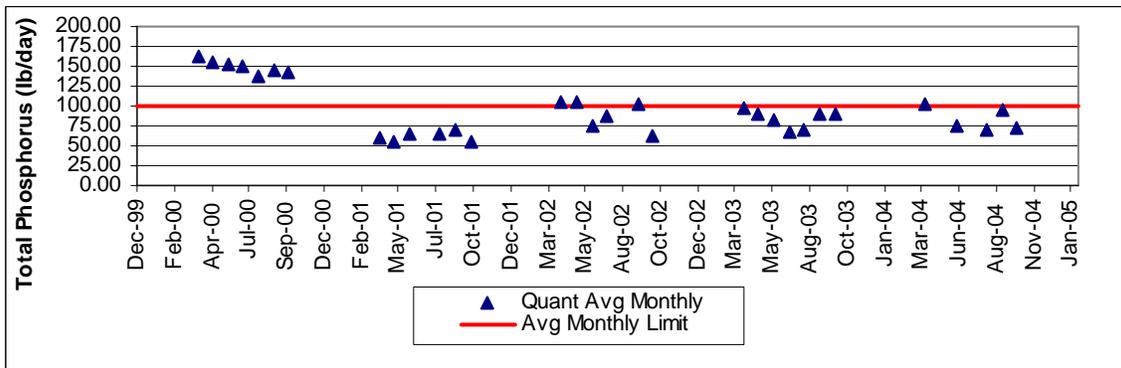


Figure B.287: West Goshen STP Phosphorus Concentration

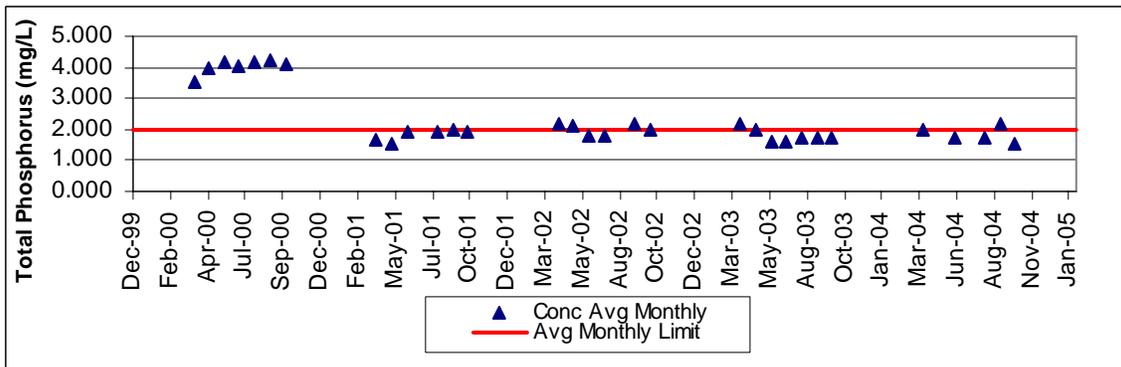


Figure B.288: West Goshen STP Lead Concentration

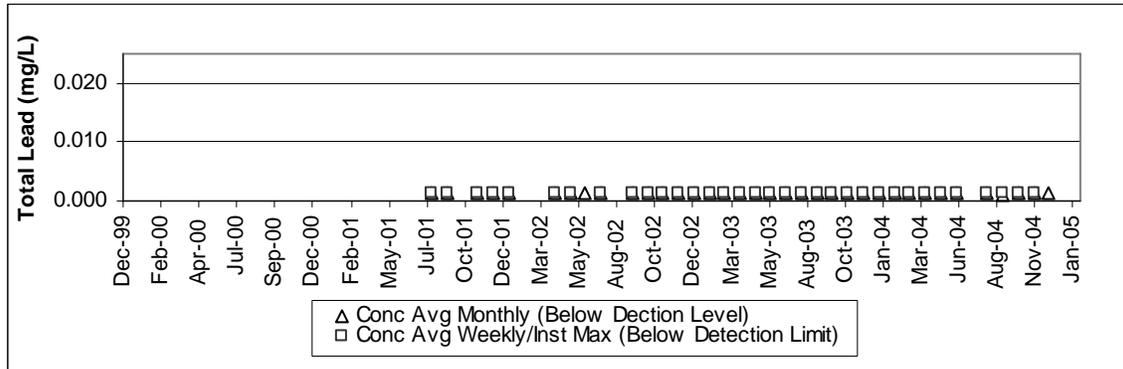


Figure B.289: West Goshen STP BIS Phthalate Concentration

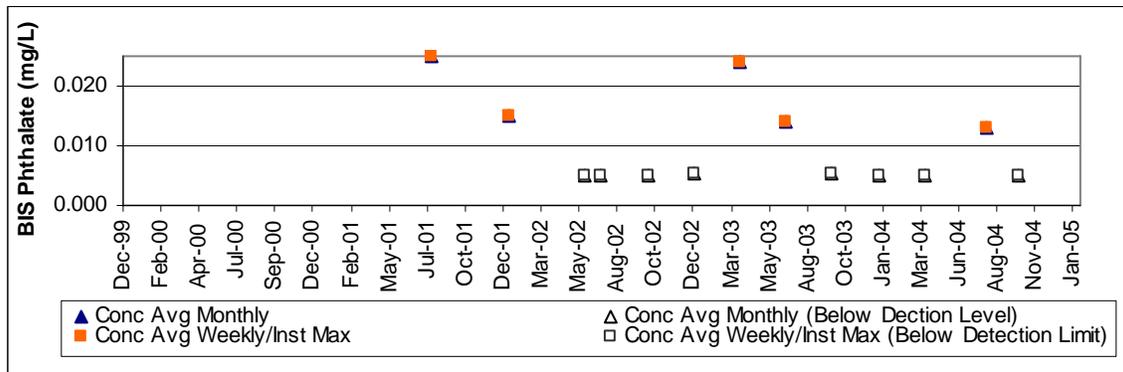


Figure B.290: Southwest Delaware County Municipal Authority WWTP Average Flow Quantity

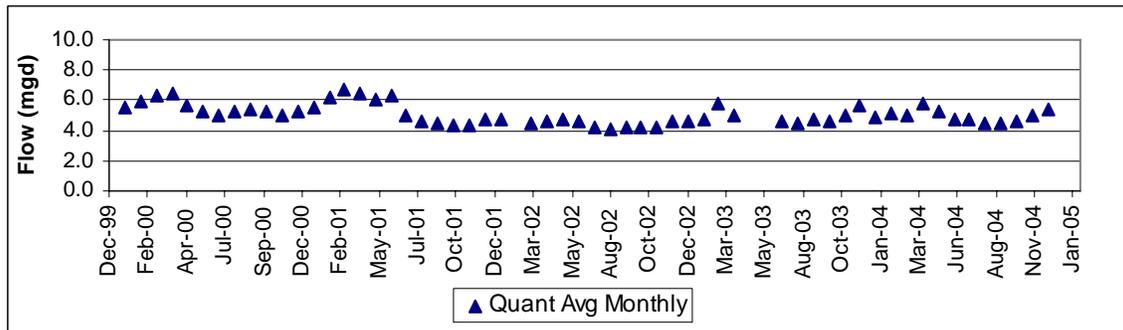


Figure B.291: Southwest Delaware County Municipal Authority WWTP CBOD5 Quantity

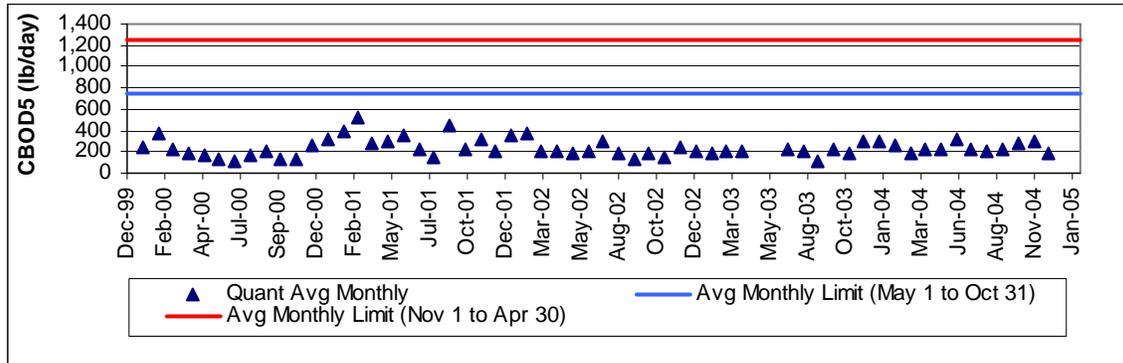


Figure B.292: Southwest Delaware County Municipal Authority WWTP CBOD5 Concentration

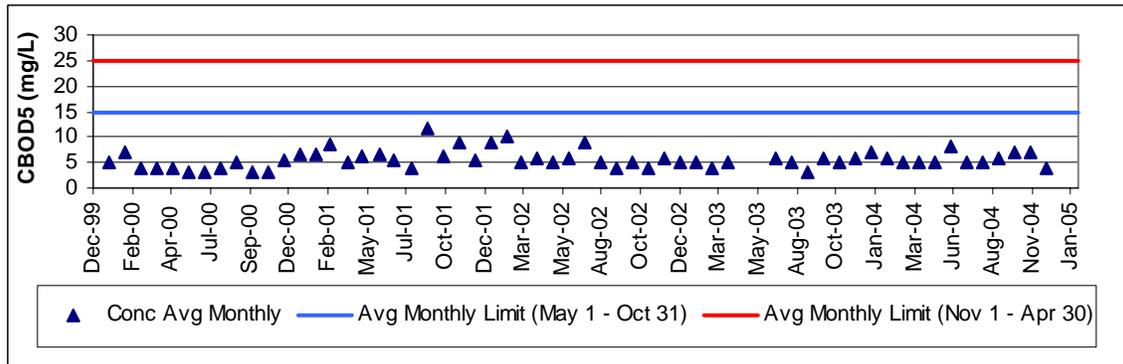


Figure B.293: Southwest Delaware County Municipal Authority WWTP pH Concentration

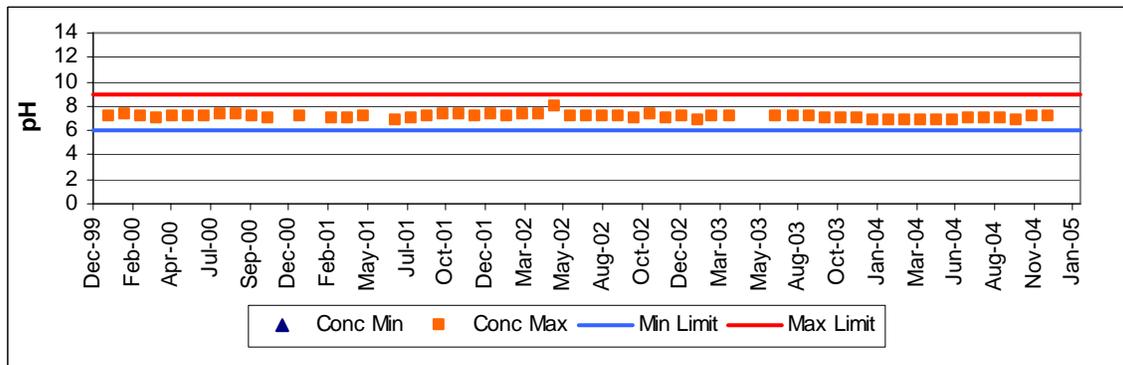


Figure B.294: Southwest Delaware County Municipal Authority WWTP TSS Quantity

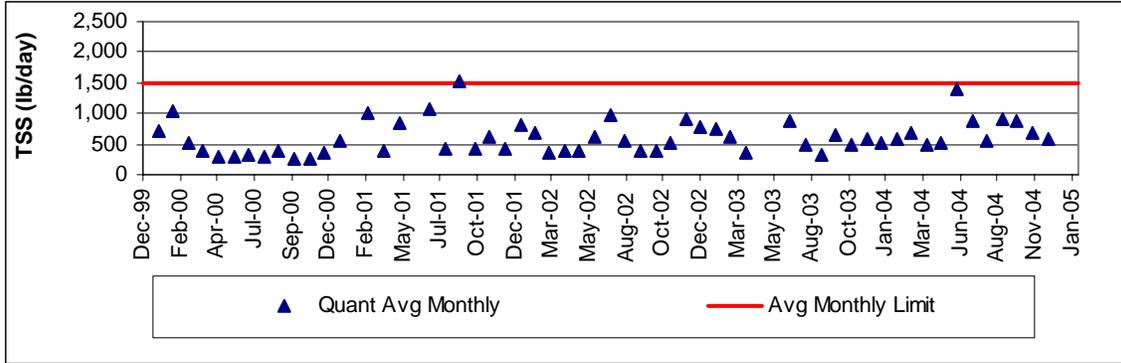


Figure B.295: Southwest Delaware County Municipal Authority WWTP TSS Concentration

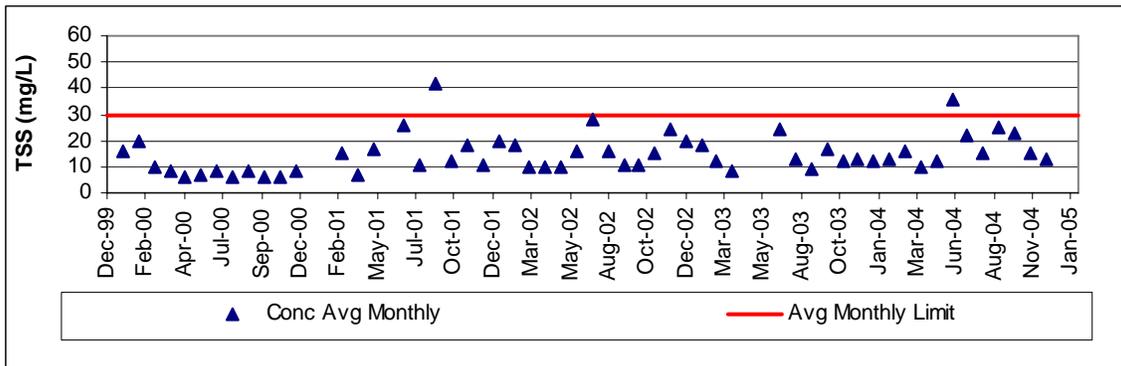


Figure B.296: Southwest Delaware County Municipal Authority WWTP Dissolved Oxygen Concentration

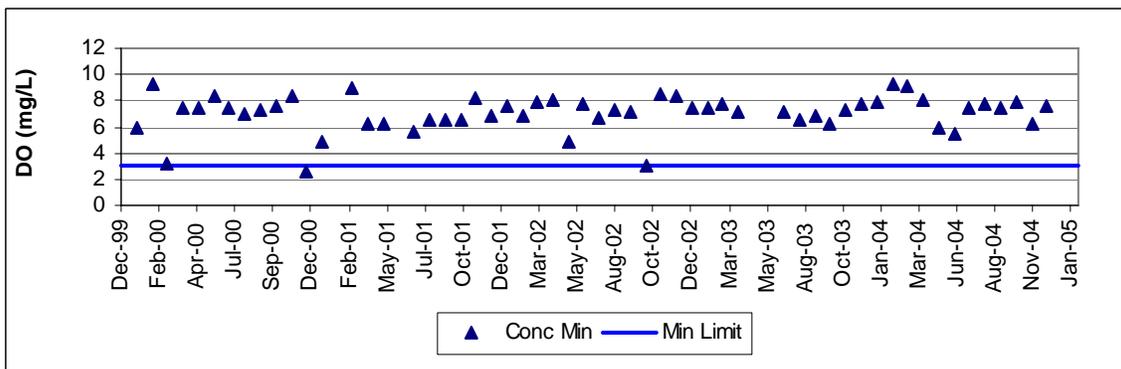


Figure B.297: Southwest Delaware County Municipal Authority WWTP Copper Concentration

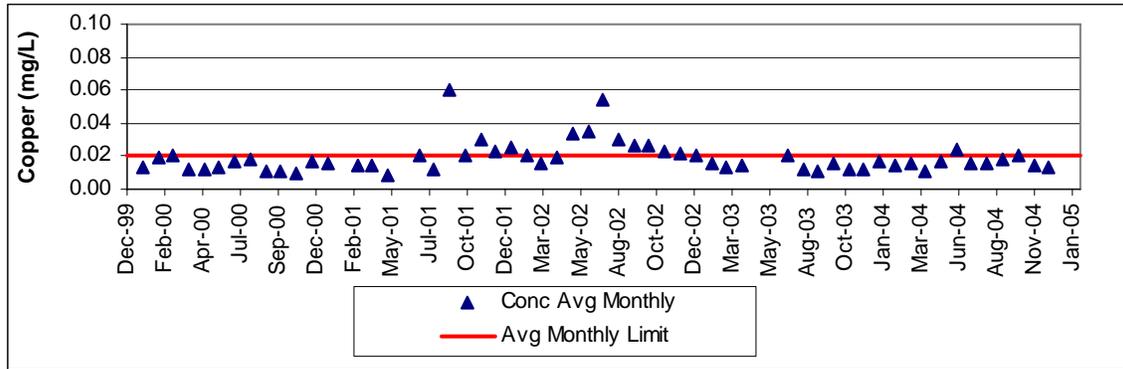


Figure B.298: Southwest Delaware County Municipal Authority WWTP Copper Quantity

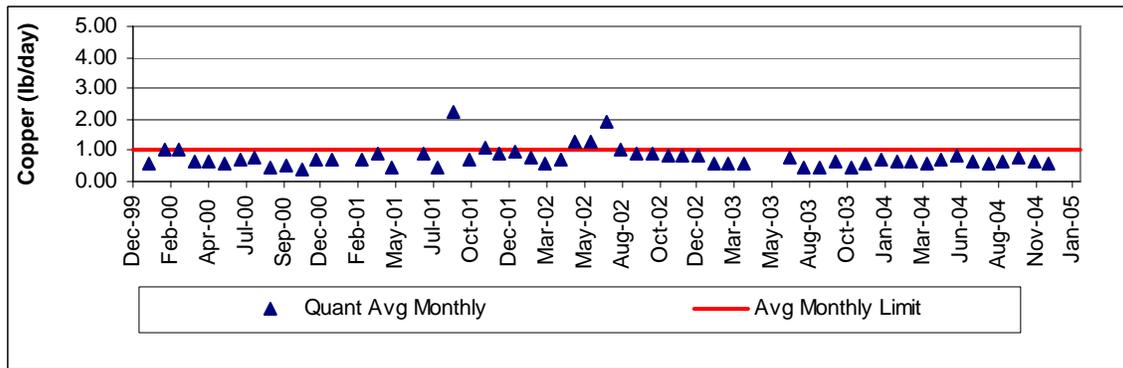


Figure B.299: Southwest Delaware County Municipal Authority WWTP Ammonia Quantity

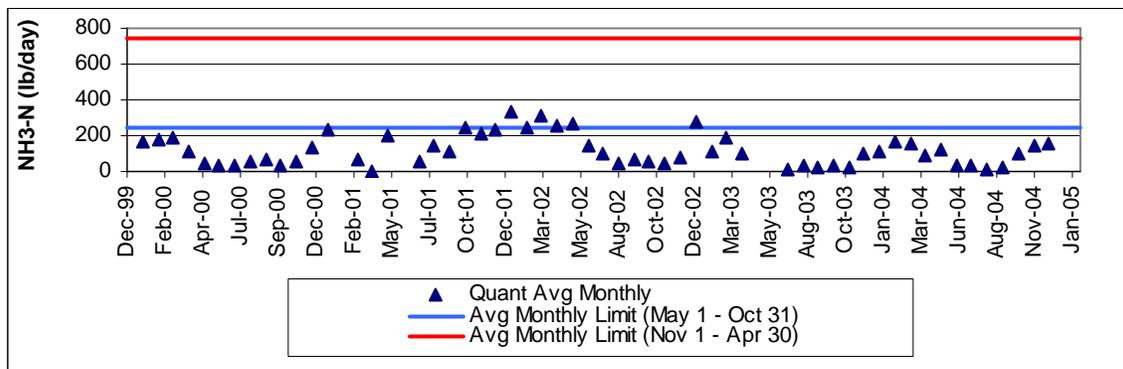


Figure B.300: Southwest Delaware County Municipal Authority WWTP Ammonia Concentration

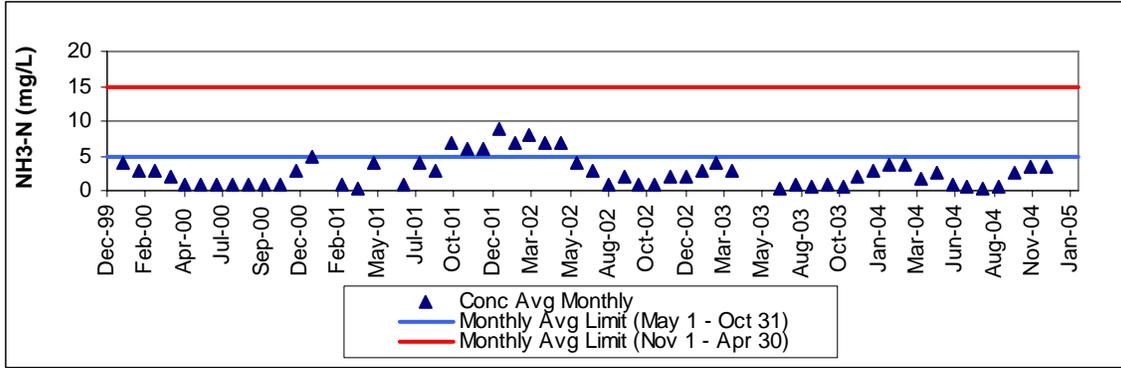


Figure B.301: Southwest Delaware County Municipal Authority WWTP Fecal Coliform Concentration

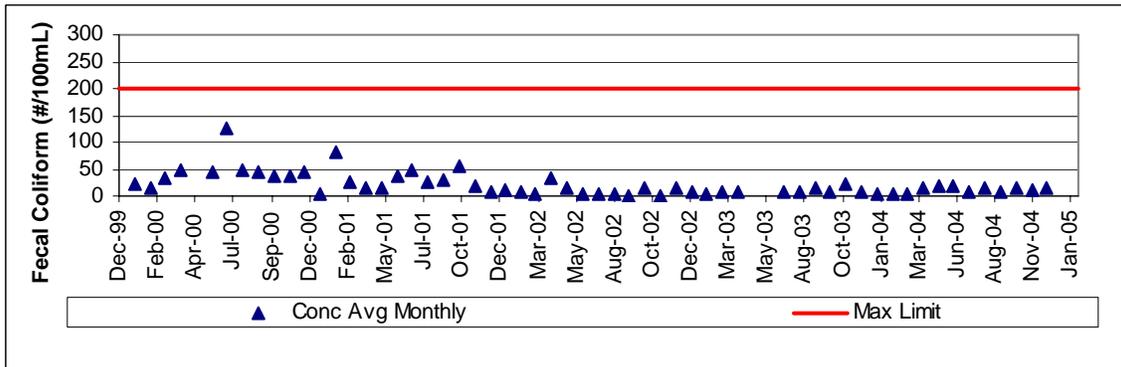


Figure B.302: Southwest Delaware County Municipal Authority WWTP Dieldrin Concentration

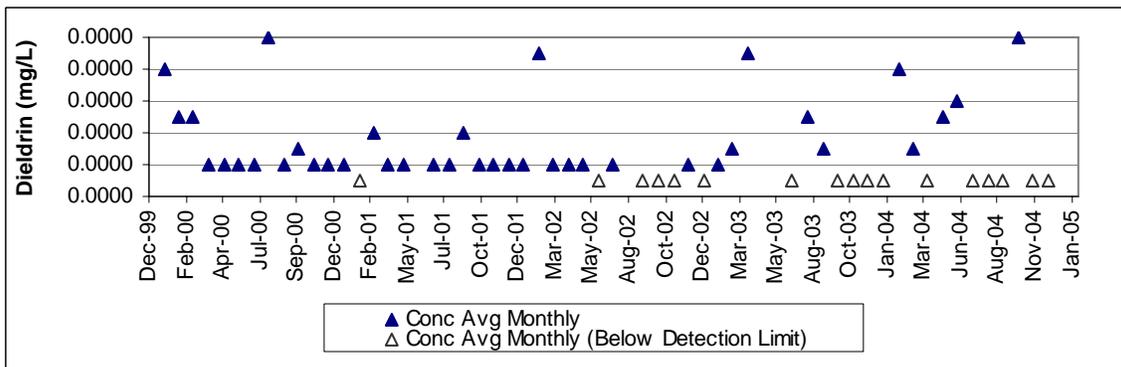


Figure B.303: Southwest Delaware County Municipal Authority WWTP Total Phenols Concentration

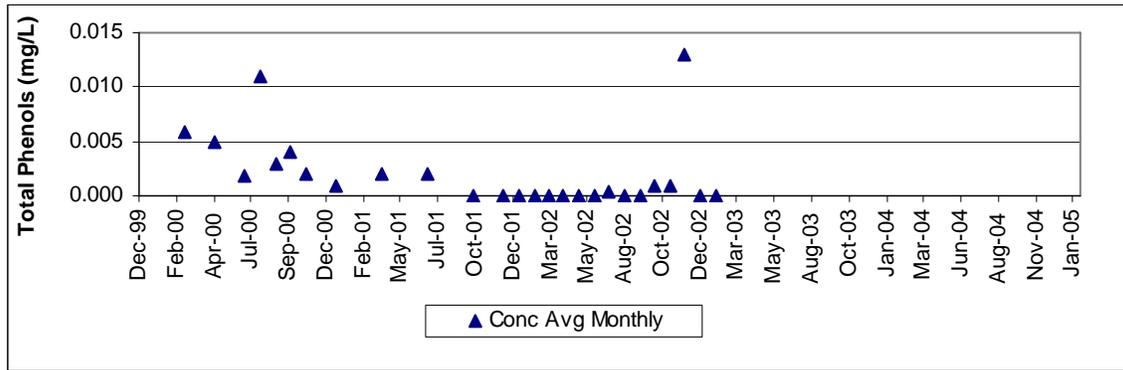


Figure B.304: Southwest Delaware County Municipal Authority WWTP Total Residual Chlorine Concentration

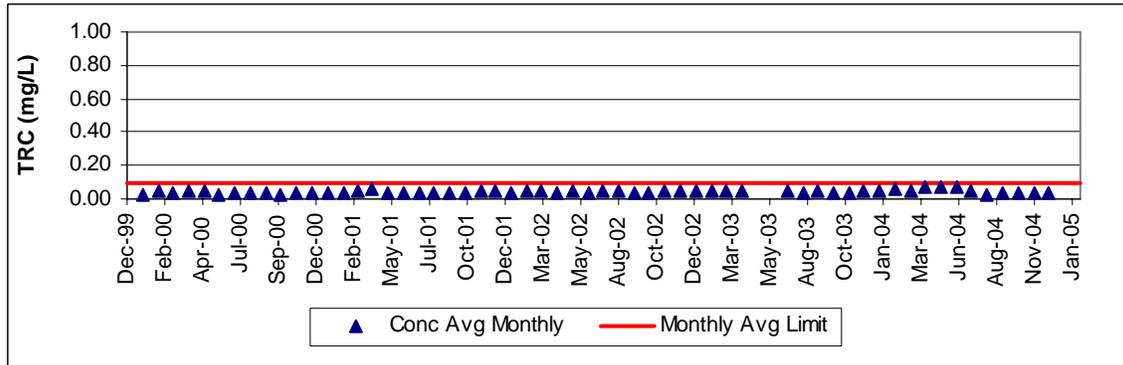


Figure B.305: Southwest Delaware County Municipal Authority WWTP Free Cyanide Quantity

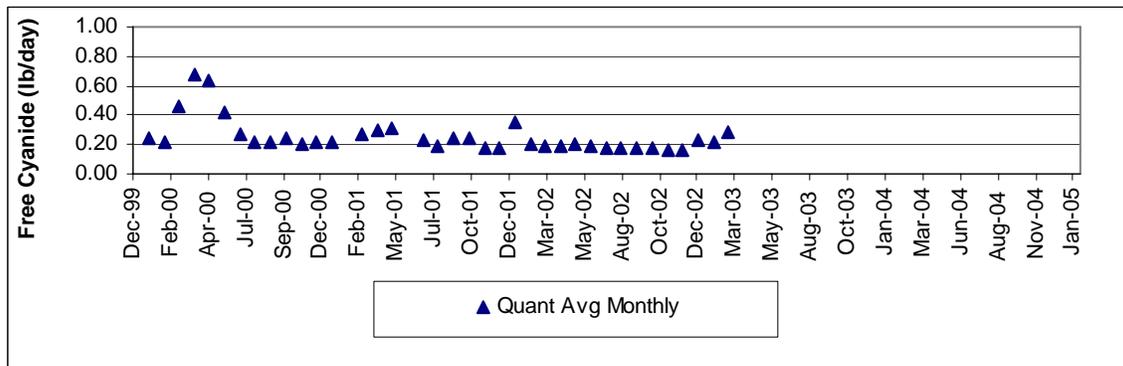


Figure B.306: Southwest Delaware County Municipal Authority WWTP Free Cyanide Concentration

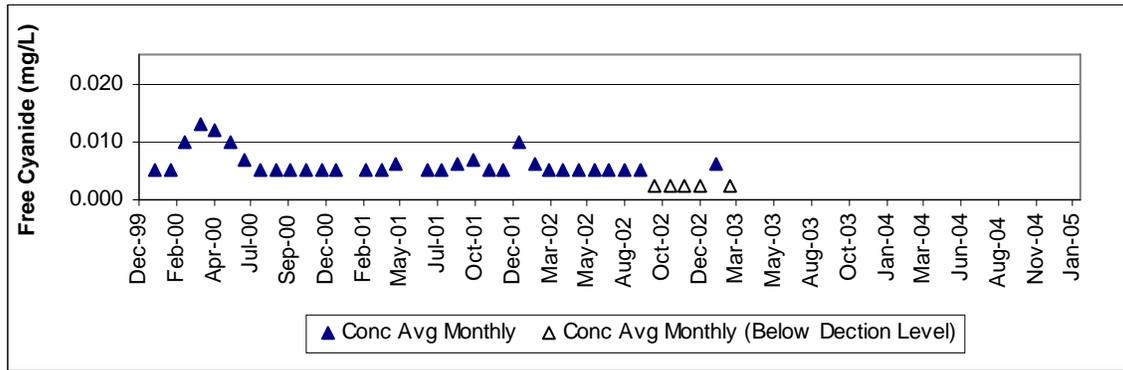


Figure B.307: Southwest Delaware County Municipal Authority WWTP BIS Phthalate Concentration

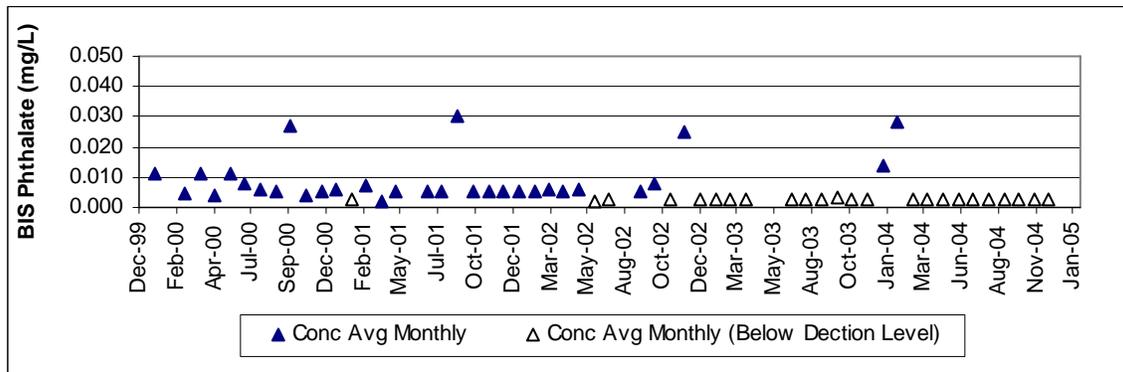


Figure B.308: Brookhaven Borough STP Flow Quantity

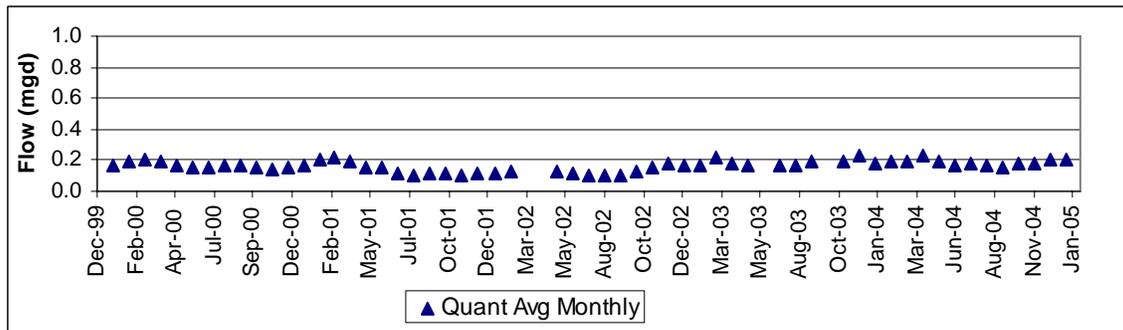


Figure B.309: Brookhaven Borough STP CBOD5 Quantity

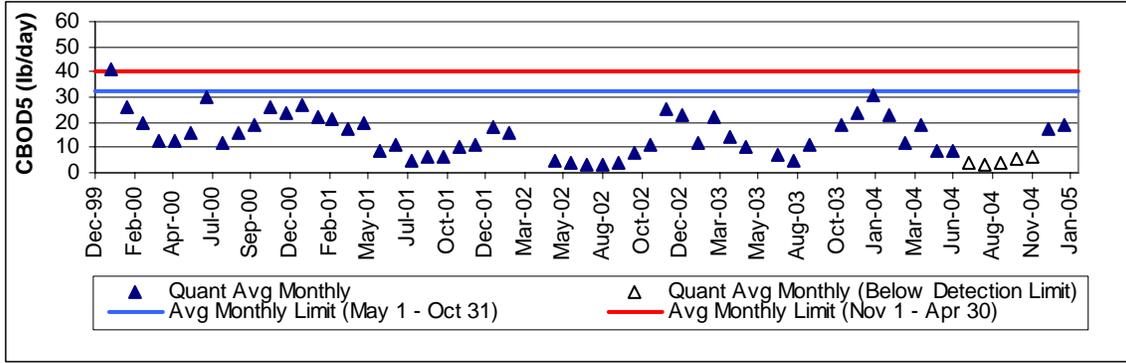


Figure B.310: Brookhaven Borough STP CBOD5 Concentration

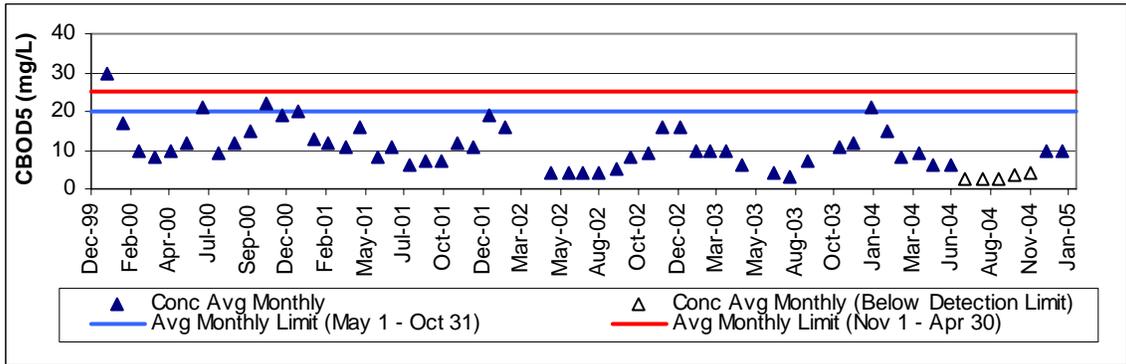


Figure B.311: Brookhaven Borough STP pH Concentration

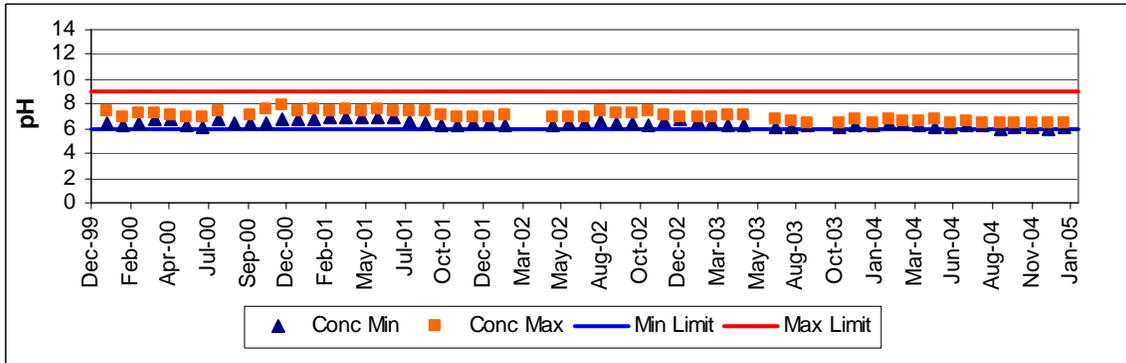


Figure B.312: Brookhaven Borough STP Total Suspended Solids Quantity

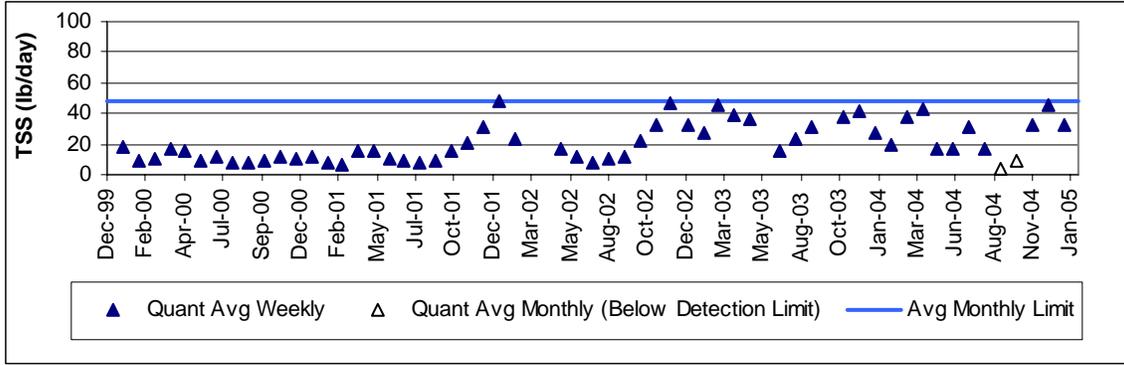


Figure B.313: Brookhaven Borough STP Total Suspended Solids Concentration

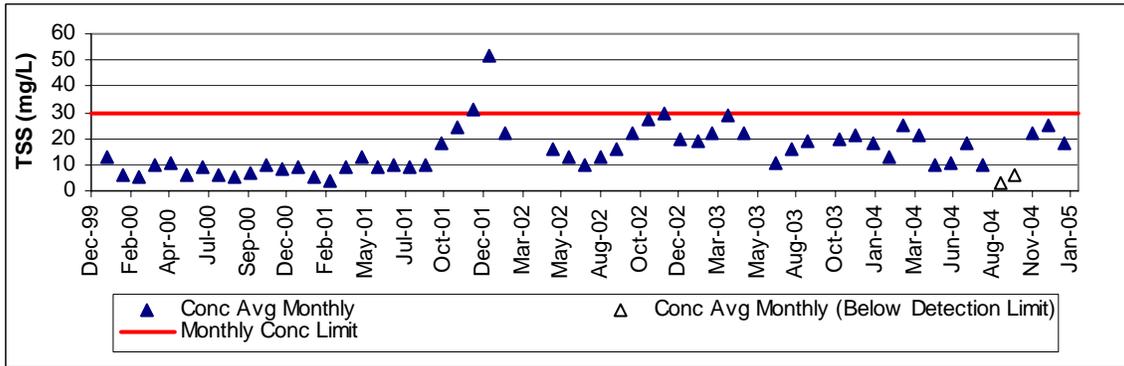


Figure B.314: Brookhaven Borough STP Dissolve Oxygen Concentration

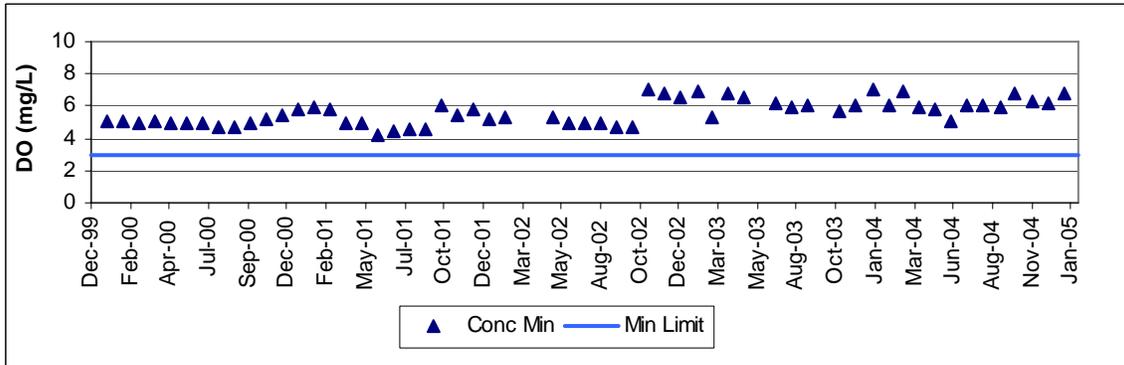


Figure B.315: Brookhaven Borough STP Ammonia Quantity

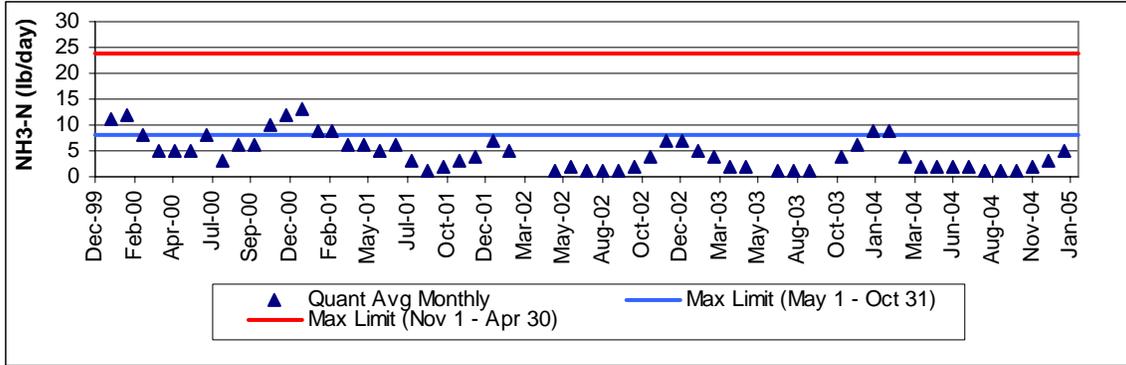


Figure B.316: Brookhaven Borough STP Ammonia Concentration

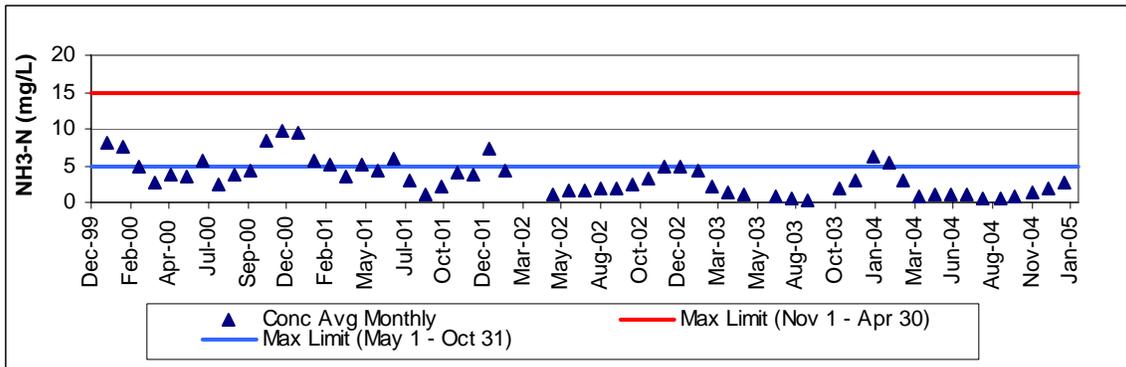


Figure B.317: Brookhaven Borough STP Fecal Coliform Concentration

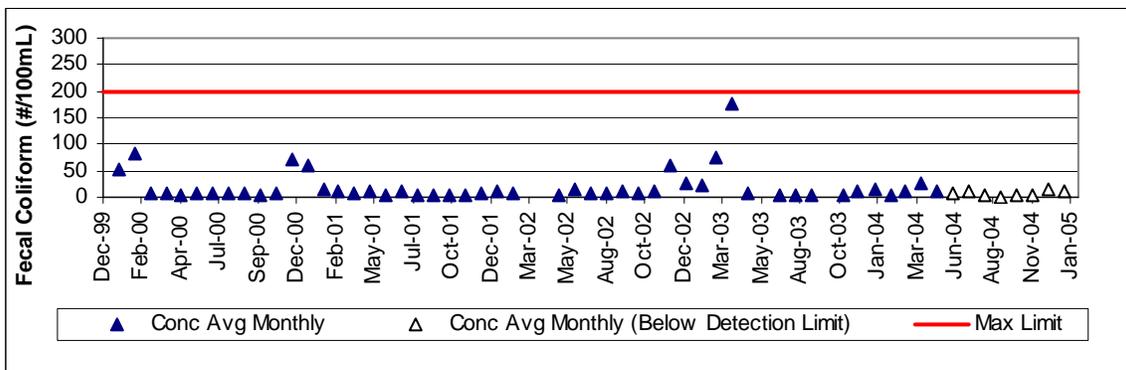


Figure B.318: Brookhaven Borough STP Zinc Concentration

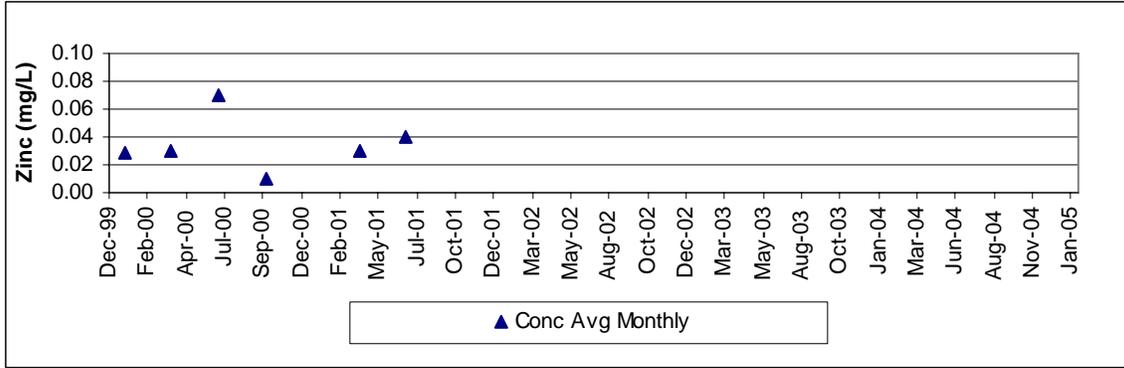


Figure B.319: Brookhaven Borough STP Silver Concentration

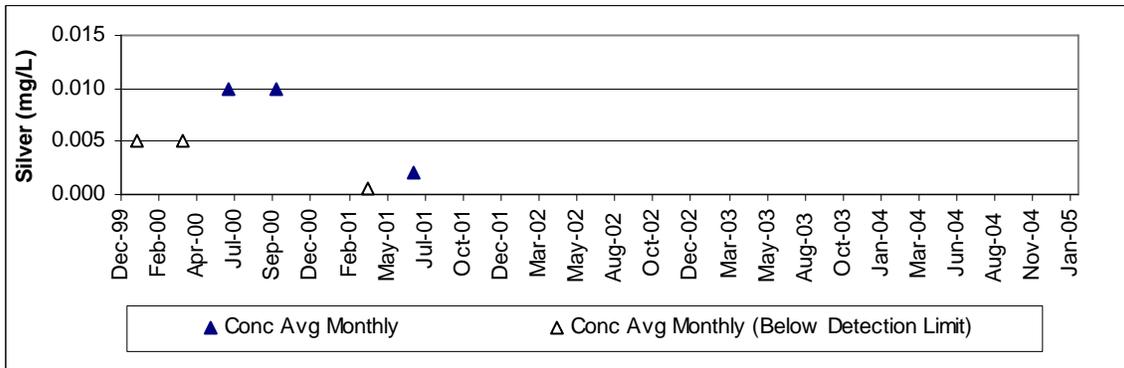


Figure B.320: Brookhaven Borough STP Total Residual Chlorine Concentration

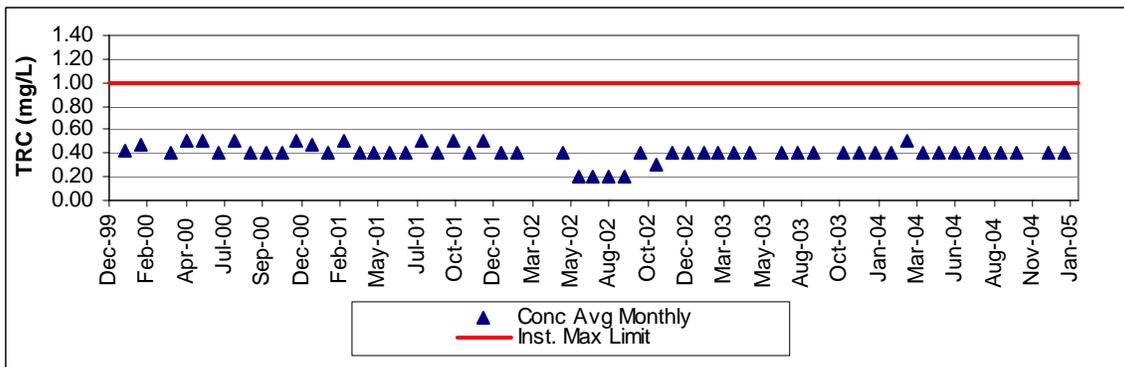


Figure B.321: Goose Creek STP Flow Quantity

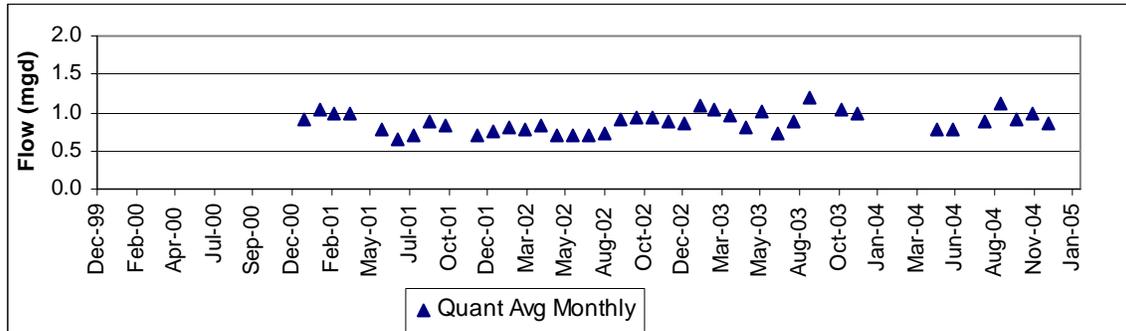


Figure B.322: Goose Creek STP CBOD5 Quantity

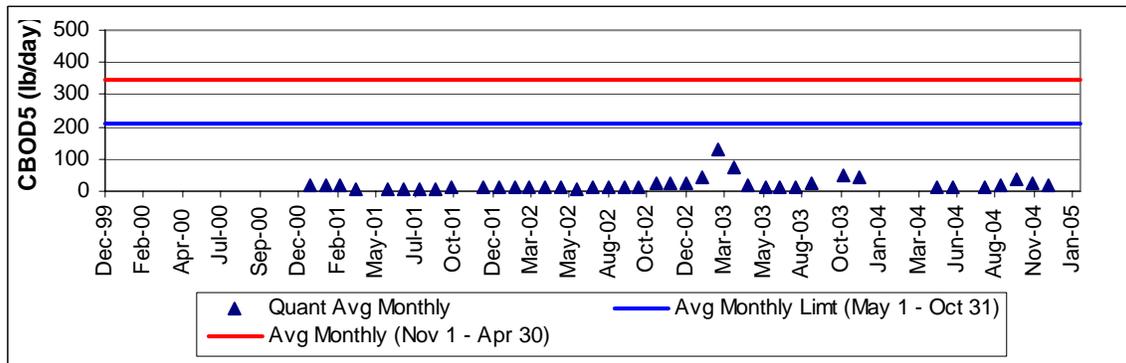


Figure B.323: Goose Creek STP CBOD5 Concentration

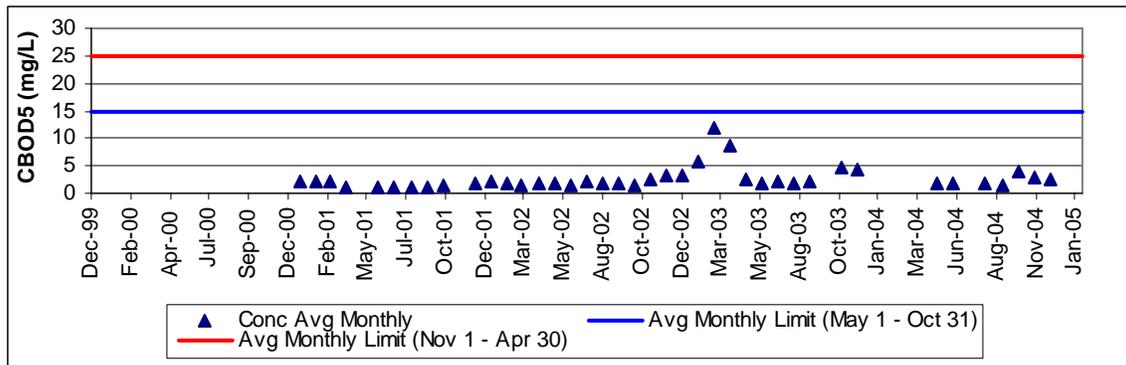


Figure B.324: Goose Creek STP pH Concentration

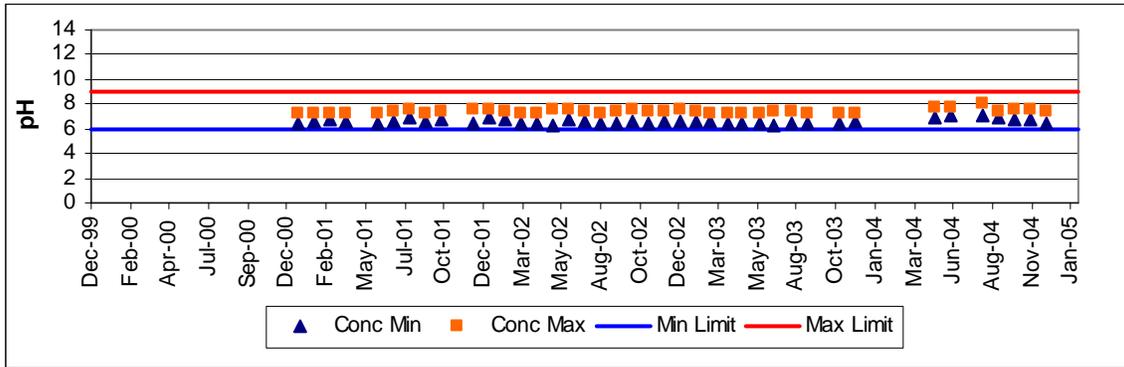


Figure B.325: Goose Creek STP Total Suspended Solids Quantity

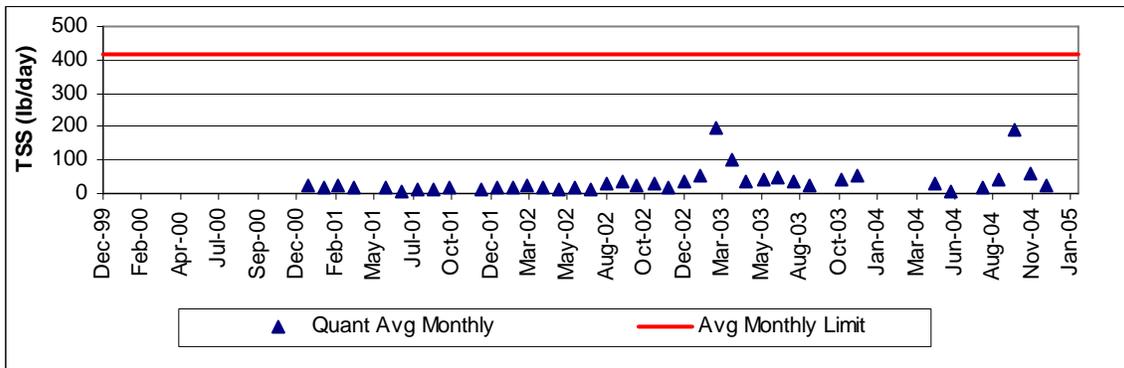


Figure B.326: Goose Creek STP Total Suspended Solids Concentration

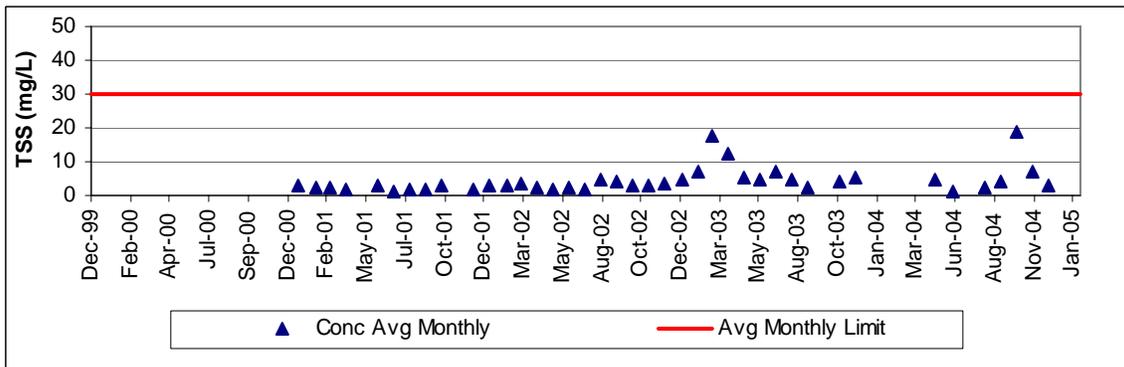


Figure B.327: Goose Creek STP Dissolved Concentration

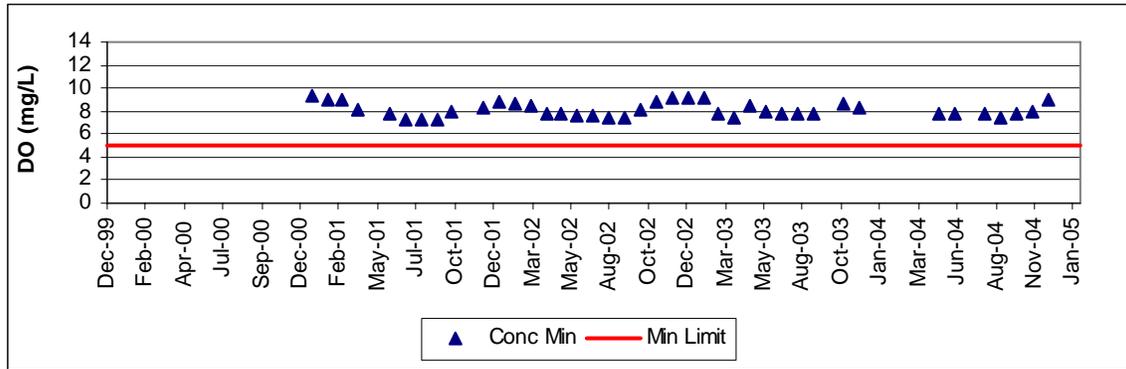


Figure B.328: Goose Creek STP Total Phenols Quantity

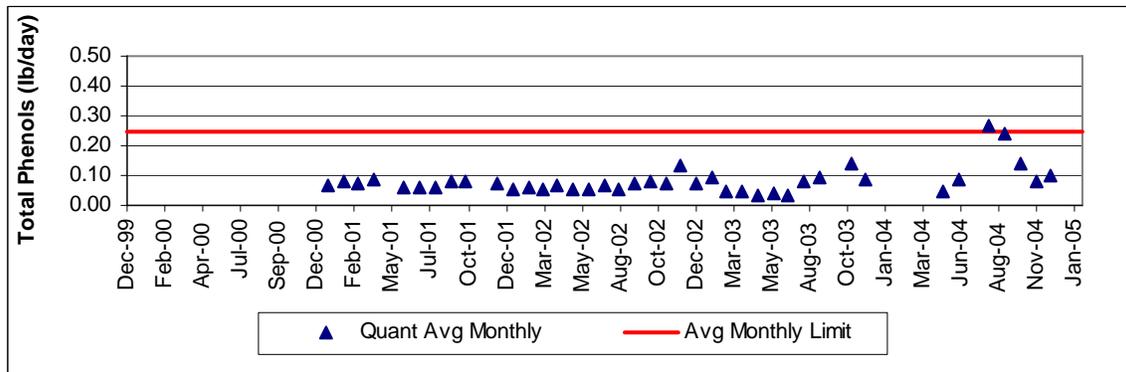


Figure B.329: Goose Creek STP Total Phenols Concentration

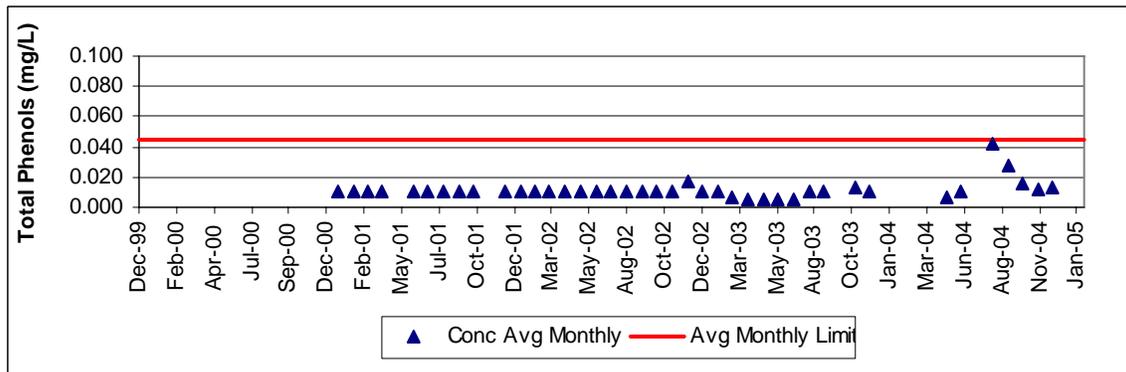


Figure B.330: Goose Creek STP Ammonia Quantity

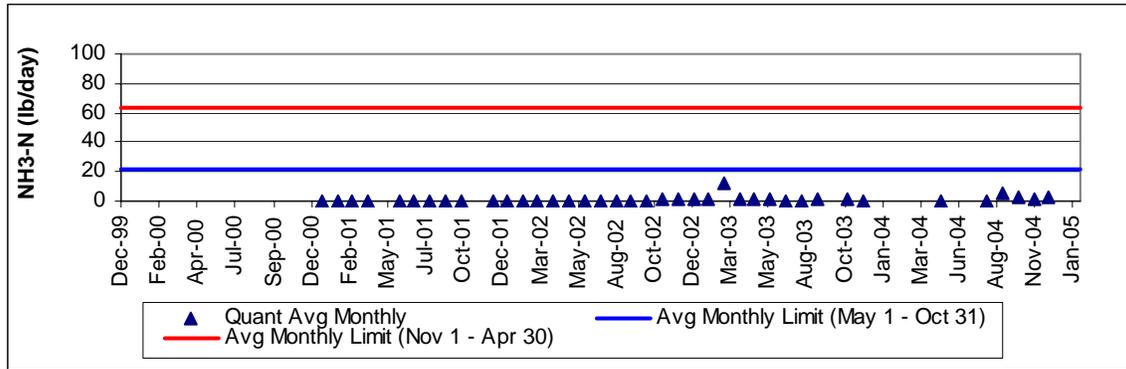


Figure B.331: Goose Creek STP Ammonia Concentration

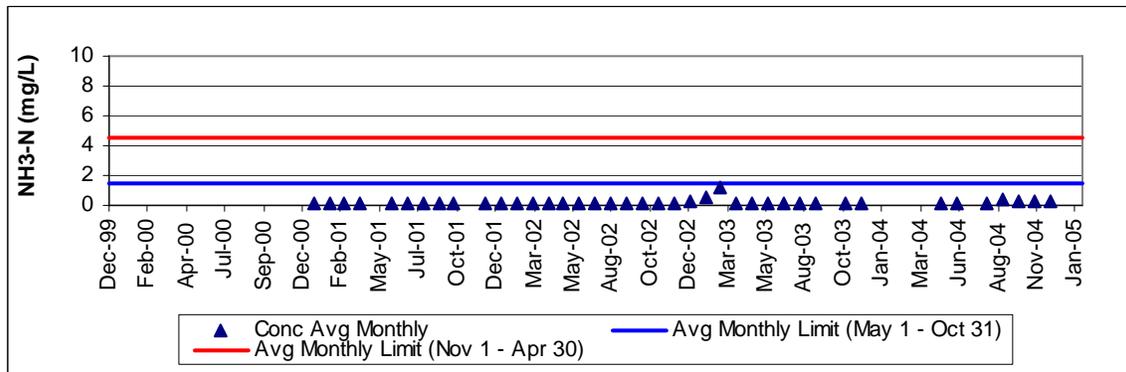


Figure B.332: Goose Creek STP Fecal Coliform Concentration

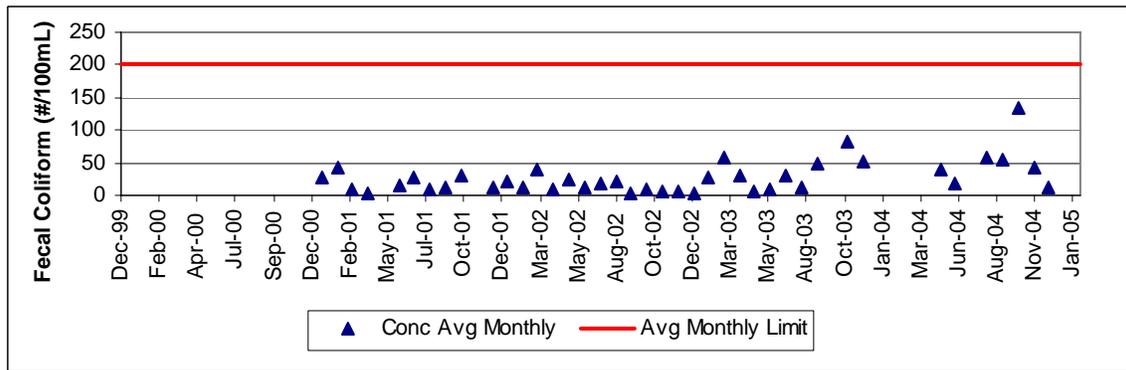


Figure B.333: Goose Creek STP Chloroform Concentration

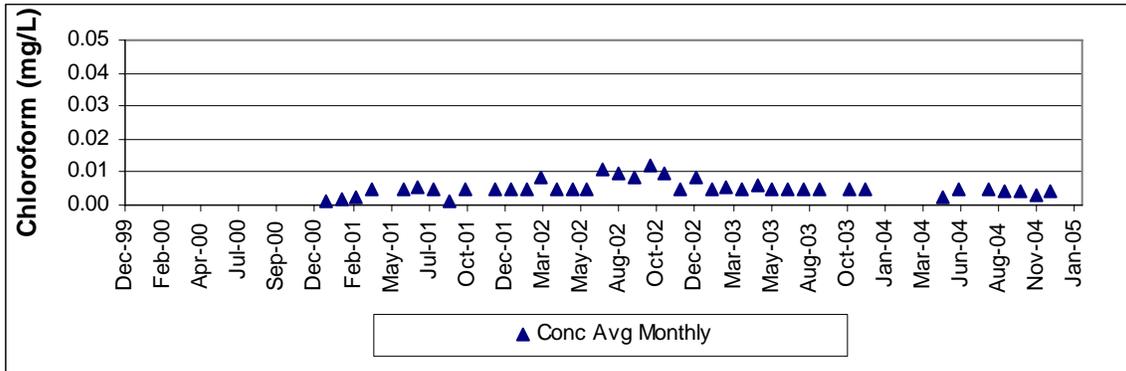


Figure B.334: Goose Creek STP Total Residual Chlorine Concentration

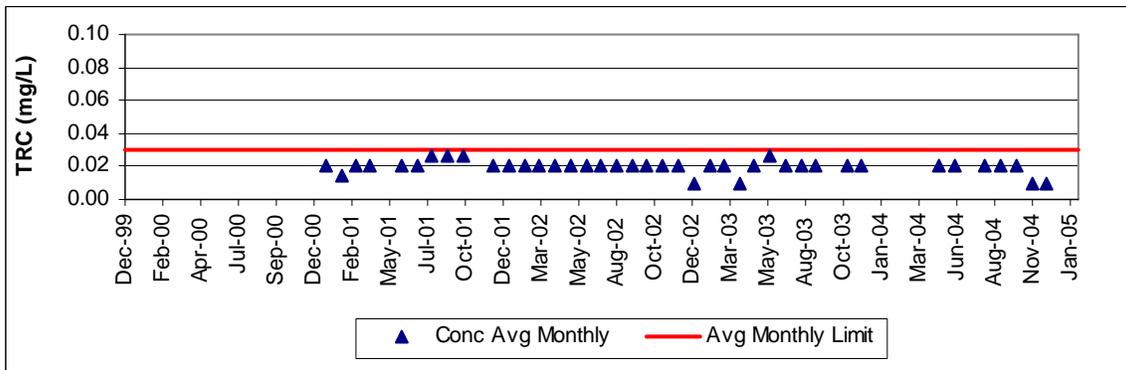


Figure B.335: Goose Creek STP Total Zinc Quantity

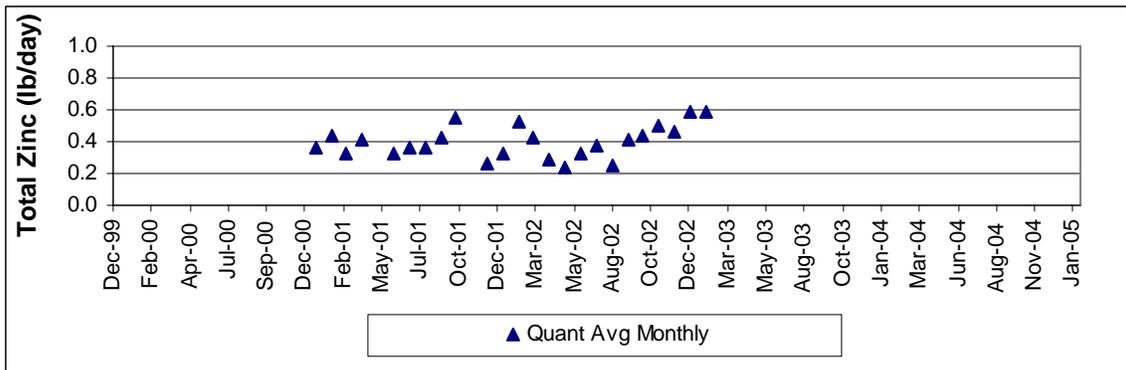


Figure B.336: Goose Creek STP Total Zinc Concentration

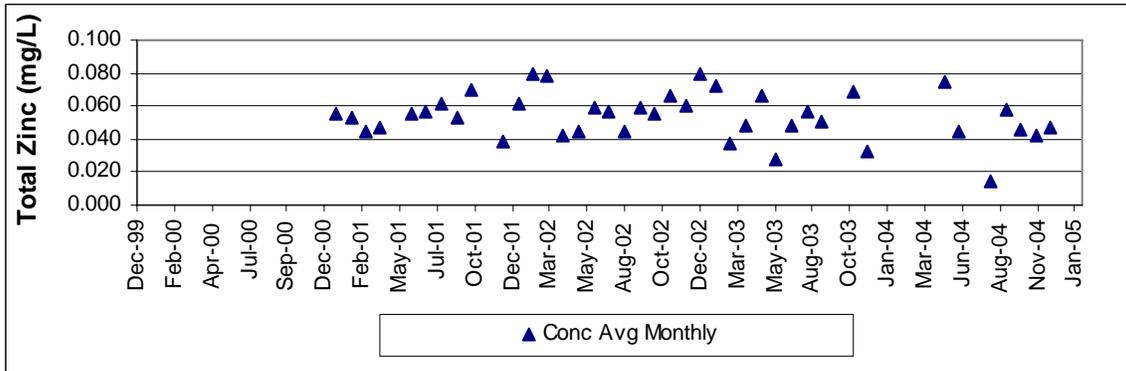


Figure B.337: Goose Creek STP Total Copper Concentration

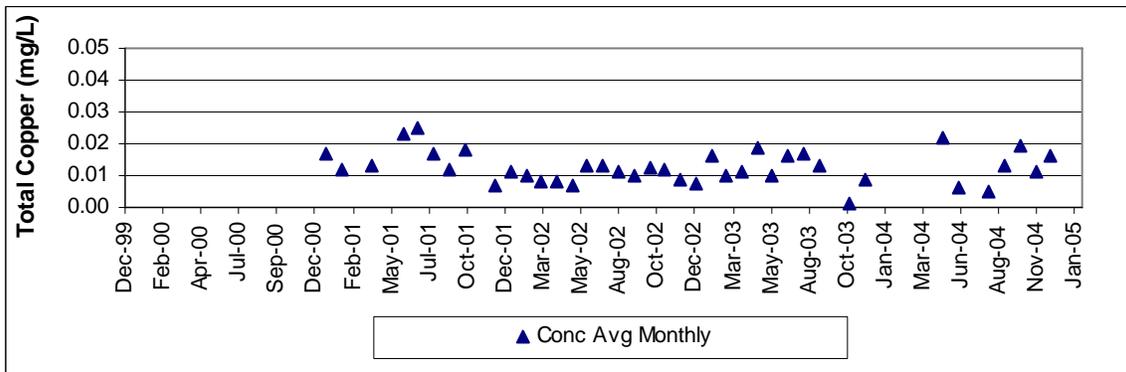
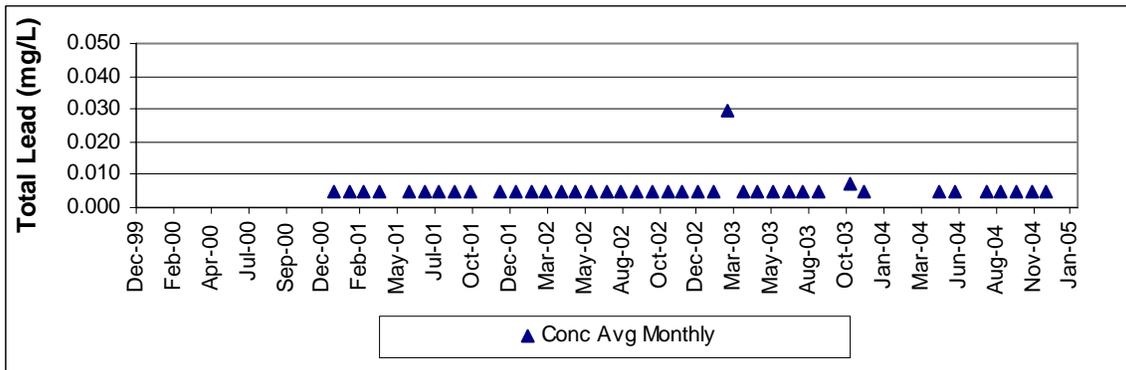


Figure B.338: Goose Creek STP Total Lead Concentration



Permit Violations

Facility Name	Permit No.	Parameter	Period of DMR Records	No. DMRs	DMR Reported Values				Permit Limits (Monthly Average)		No of Exceedances of Permit Limits	
					Quantity (lb/day)		Concentration (mg/L)		Quantity (lb/day)	Concentration (mg/L)	Quantity (lb/day)	Concentration (mg/L)
					Avg	Max	Avg	Max				
Westlake Plastics IWTP	PA0051438	Oil & Grease	1/00 - 12/04	57	-	-	51.4	1170	-	15	-	3
		Total Suspended Solids			-	-	16.5	332	-	30	-	5
Glen Mills School STP	PA0031747	Fecal Coliform	1/00 - 12/04	53	-	-	17.6	283	-	200	-	1
		TRC			-	-	0.42	0.7	-	0.5	-	9
Brinton Manor STP	PA0044474	Fecal Coliform	1/00 - 8/04	55	-	-	26.7	251	-	200	-	1
Concord Beverage IWTP	PA0050431	Total Suspended Solids	1/00 - 11/04	53	-	-	10.5	47	-	30	-	2
		Ammonia (May 1 - Oct 31)			0.27	3.91	1.36	13.8	1.2	2	1	6
Fox Valley Community STP	PA0030431	Total Suspended Solids	1/00 - 12/04	60	-	-	10.7	31.5	-	30	-	1
		Fecal Coliform			-	-	56.8	948	-	200	-	5
		TRC			-	-	0.43	0.54	-	0.5	-	1
Concord Industrial Park STP	PA0032301	Ammonia (Nov 1 - Apr 30)	1/00 - 12/04	56	-	-	0.74	15.7	-	9	-	1
Valley Brook Homeowners Association STP	PA0040576	TRC	1/00 - 12/04	59	-	-	0.4	0.6	-	0.5	-	5
Concord Township Central STP	PA0055212	CBOD (Nov 1 - Apr 30)	1/00 - 12/04	58	35.3	218	10.1	61	250	25	0	1
		CBOD (May 1 - Oct 31)			35.3	218	10.1	61	200	20	0	1
		Total Suspended Solids			49.9	169	13.2	46.6	300	30	0	3
		Ammonia (Nov 1 - Apr 30)			3	61.4	0.91	19.2	60	6	0	1
		Ammonia (May 1 - Oct 31)			3	61.4	0.91	19.2	20	2	0	1

Facility Name	Permit No.	Parameter	Period of DMR Records	No. DMRs	DMR Reported Values				Permit Limits (Monthly Average)		No of Exceedances of Permit Limits	
					Quantity (Ib/day)		Concentration (mg/L)		Quantity (Ib/day)	Concentration (mg/L)	Quantity (Ib/day)	Concentration (mg/L)
					Avg	Max	Avg	Max				
Garnet Valley HS STP	PA0031208	Total Suspended Solids	1/00 - 12/04	60	0.49	2.71	7.93	31	1.85	10	2	10
		Ammonia (May 1 - Oct 31)			0.1	0.82	1.51	9	0.56	3	0	2
River at Concord STP	PA0054780	pH	10/03 - 10/04	12	-	-	6.41	6.81	-	6 (min)	-	1
Coventry Crossing Apartments STP	PA0052434	Total Suspended Solids	1/00 - 12/04	60	0.6	5.8	3.27	24	3.3	10	1	1
		Ammonia (Nov 1 - Apr 30)			0.17	1.8	0.66	4.8	1.7	5.1	1	0
		Ammonia (May 1 - Oct 31)			0.17	1.8	0.66	4.8	0.2	1.7	0	1
		Total Residual Chlorine			-	-	0.03	0.6	-	0.04	-	2
Concordville Hotel STP	PA0052744	Total Suspended Solids	1/00 - 12/04	60	1.61	63	5.34	19	6.3	30	1	0
		Ammonia (May 1 - Oct 31)			0.12	0.84	1.22	8.2	0.6	3	1	1
		Total Residual Chlorine			-	-	0.09	0.6	-	0.13	-	1
Concord Country Club	PA0031666	Total Suspended Solids	1/00 - 12/04	59	-	-	15.9	50	-	30	-	3
		Ammonia (May 1 - Oct 31)			-	-	1.69	9	-	5	-	3
		Fecal Coliform			-	-	353	6995	-	200	-	8
		Total Residual Chlorine			-	-	0.41	0.6	-	0.5	-	6
Southco STP	PA0051161	CBOD5 (Nov 1 - Apr 30)	1/00 - 12/04	55	-	-	4.07	26	-	9	-	1
		Total Suspended Solids			-	-	3.33	18	-	10	-	3
		Ammonia (May 1 - Oct 31)			-	-	1.32	16.9	-	3	-	1
		Ammonia (Nov 1 - Apr 30)			-	-	1.32	16.9	-	9	-	2
		Fecal Coliform			-	-	36	840	-	200	-	1
Springhill Farm STP	PA0052230	Total Suspended Solids	1/00 - 9/04	57	4.86	18	11.1	45	25	30	0	2
		Fecal Coliform			-	-	77	382	-	200	-	4
		Total Residual Chlorine			-	-	0.24	0.56	-	0.06	-	29
Sleighton School STP	PA0029980	Ammonia (May 1 - Oct 31)	1/00 - 12/04	57	0.2	4.05	1.14	9.7	1.3	3.5	1	0
		Ammonia (Nov 1 - Apr 30)			0.2	4.05	1.14	9.7	3.9	10.5	1	0
		Fecal Coliform			-	-	36	1258	-	200	-	1

Facility Name	Permit No.	Parameter	Period of DMR Records	No. DMRs	DMR Reported Values				Permit Limits (Monthly Average)		No of Exceedances of Permit Limits	
					Quantity (lb/day)		Concentration (mg/L)		Quantity (lb/day)	Concentration (mg/L)	Quantity (lb/day)	Concentration (mg/L)
					Avg	Max	Avg	Max				
Cheyney University STP	PA0030970	Total Residual Chlorine	1/00 - 12/04	56	-	-	0.36	0.58	-	0.5	-	1
		Ammonia (May 1 - Oct 31)			1.46	5.79	2.24	7.08	14.6	6.5	0	1
Westtown-Chester Creek STP	PA0031771	Ammonia (May 1 - Oct 31)	1/00 - 12/04	51	1.36	10	0.44	3.8	10	2.5	0	1
Westtown School STP	PA0050652	CBOD5 (May 1 - Oct 31)	1/00 - 12/04	52	1.29	10.5	7.86	56.5	5	20	1	1
		Total Suspended Solids			2.31	19.5	13.8	105	7.5	30	2	3
		Fecal Coliform			-	-	2045	47244	-	200	-	7
		Dissolved Oxygen			-	-	4.4	9	-	3	-	1
		Total Residual Chlorine			-	-	0.831	1.5	-	0.5	-	35
Brookhaven Borough WWTP	PA0023949	CBOD5 (May 1 - Oct 31)	1/00 - 1/05	57	15.5	41	11.2	30	32	20	0	1
		CBOD5 (Nov 1 - Apr 30)			15.5	41	11.2	30	40	25	1	1
		Total Suspended Solids			21.5	48	15.6	52	48	30	0	2
		Ammonia (May 1 - Oct 31)			4.64	13	3.43	9.6	8	5	0	1
Southwest Delaware County Municipal Authority WWTP	PA0027383	Total Suspended Solids	1/00 - 12/04	58	607	1539	15	42	1500	30	1	2
		Dissolved Oxygen			-	-	7	2.6 (min)	-	3 (min)	-	1
		Total Copper			0.77	2.25	0.019	0.06	1.05	0.021	5	12
		Ammonia (May 1 - Oct 31)			118	337	2.76	9	150	3	1	2
West Goshen STP	PA0028584	Total Phosphorus (Apr 1 - Oct 31)	1/00 - 12/04	55	95.4	162	2.35	4.22	100	2	7	7
Goose Creek STP	PA0027031	Total Phenols	1/01 - 12/04	40	0.08	0.27	0.011	0.042	0.25	0.018	1	0